

# An Introduction to the Histology of Lepidoptera

Ray B. Nagle

# Histologic Preparation

- Tissue is fixed by cross-linking or precipitating proteins.
- Tissue is dehydrated and embedded in wax (paraffin).
- Thin (3-6um) sections are cut onto glass slides using microtome.
- Sections are de-waxed, rehydrated, and stained and coverslipped.

# Insect Histology

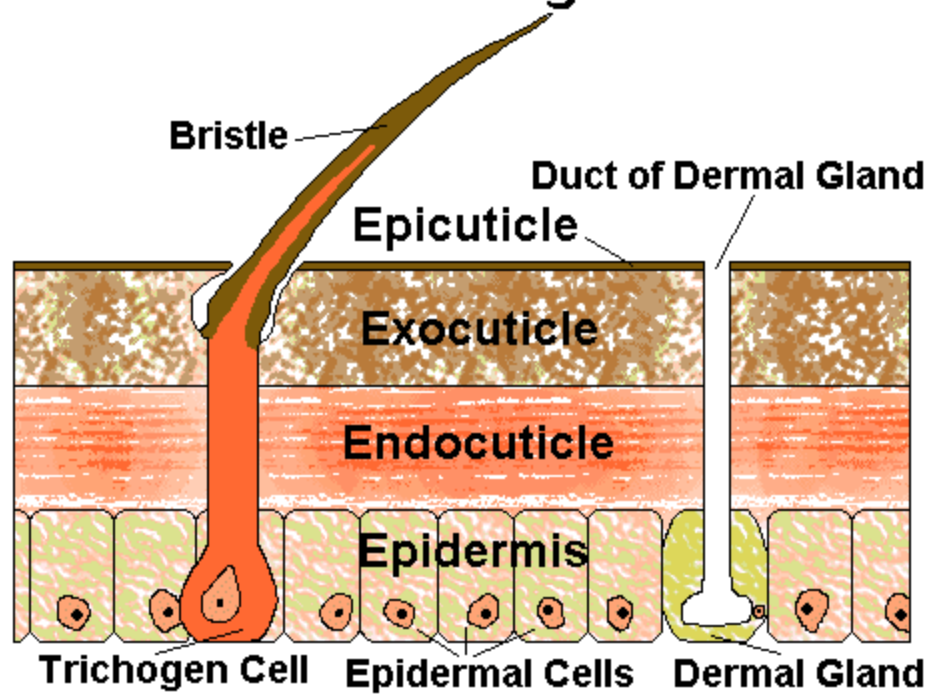


# Insect Histology Preparation

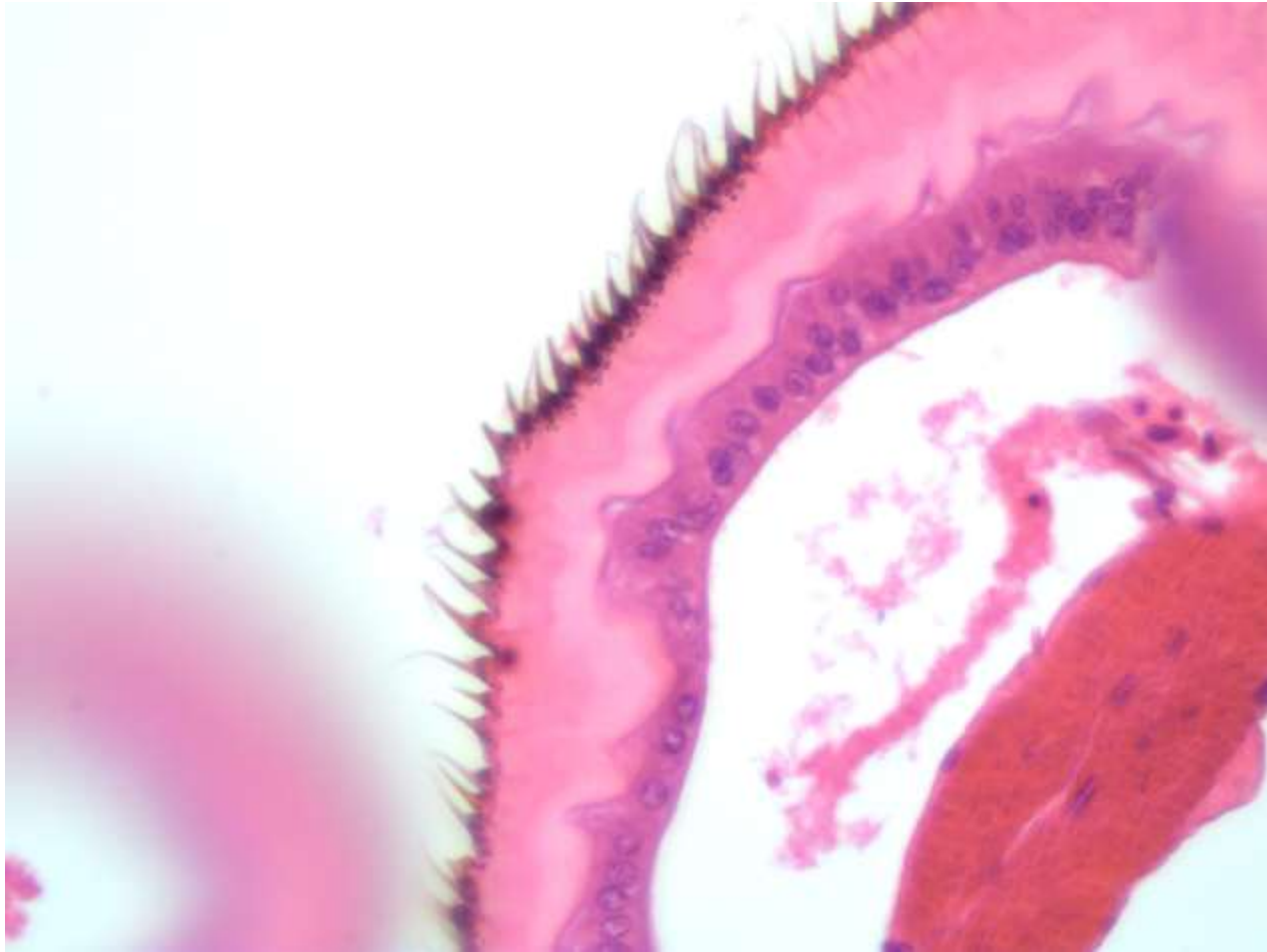


# The Integument

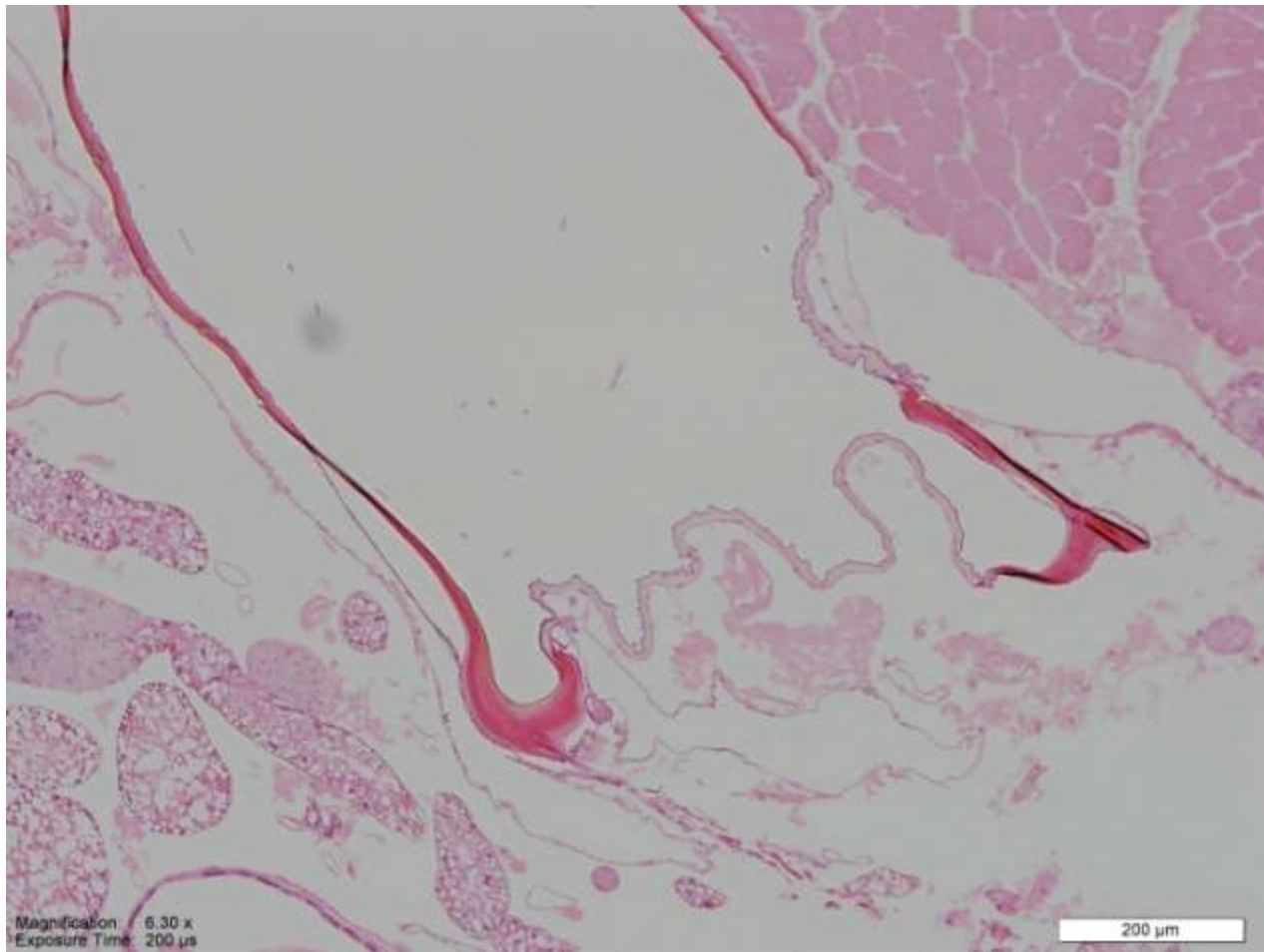
## The Insect Integument



# Epidermis



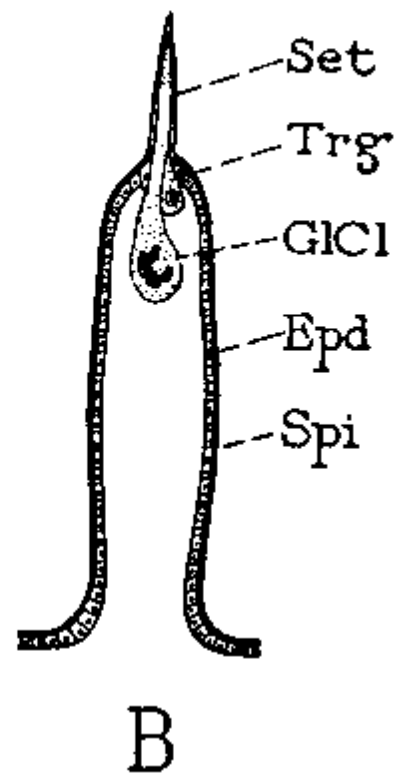
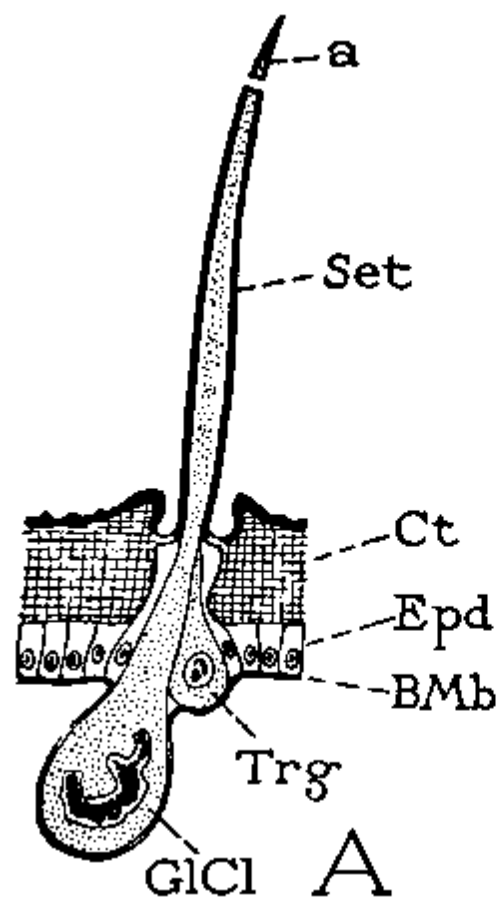
# Intersegmental Cuticle



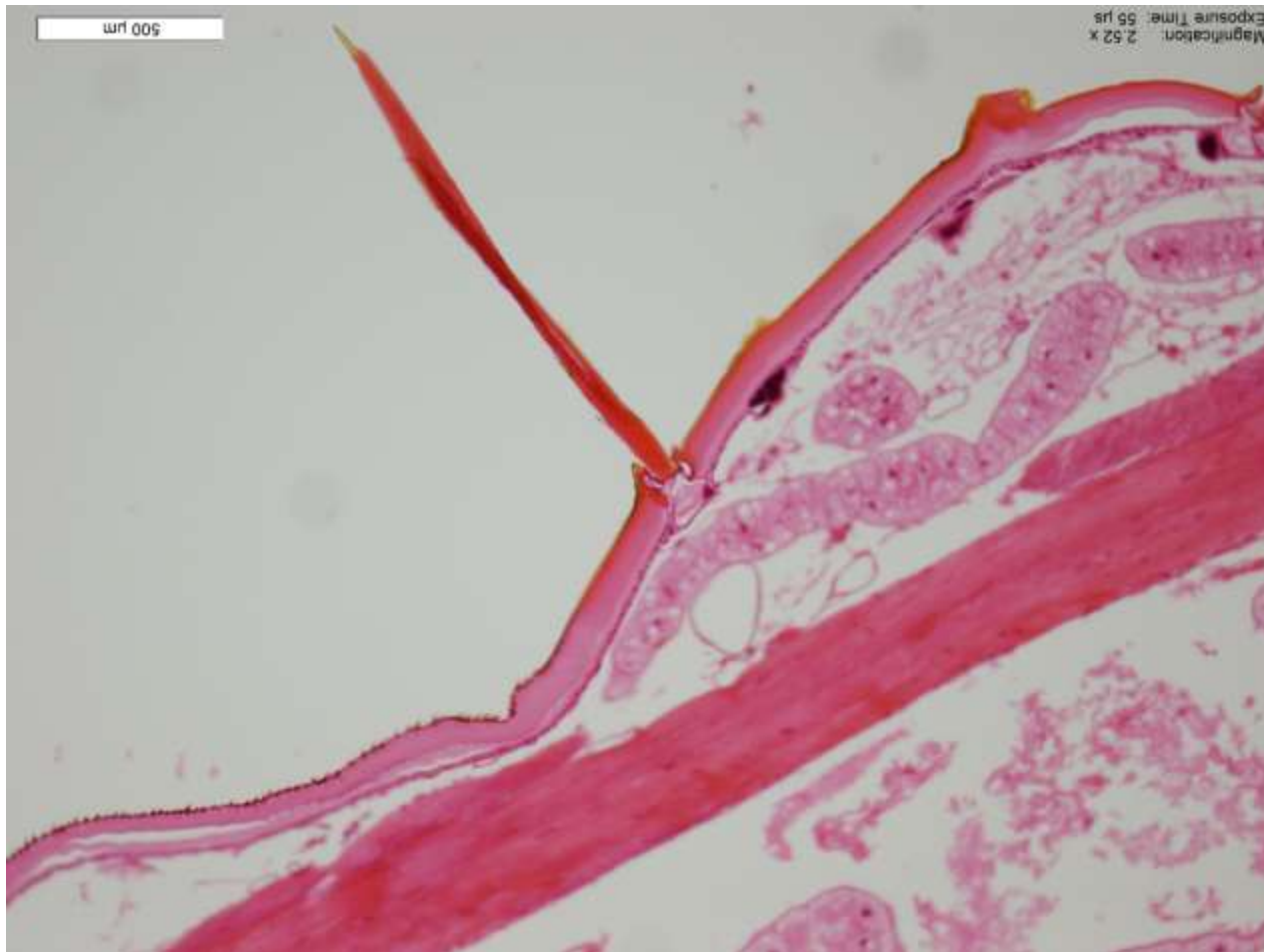


# Head Capsule vs Thoracic integument

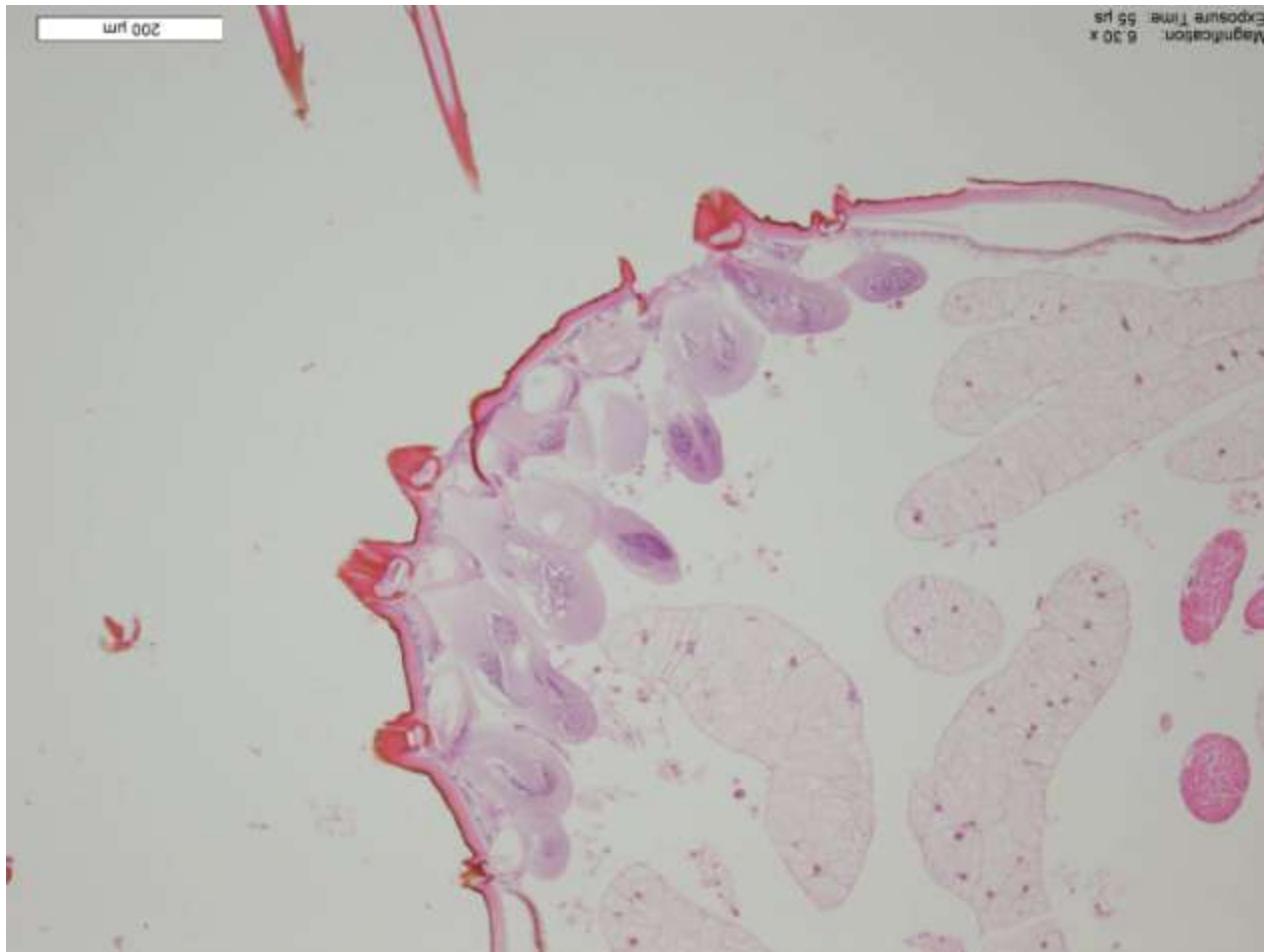


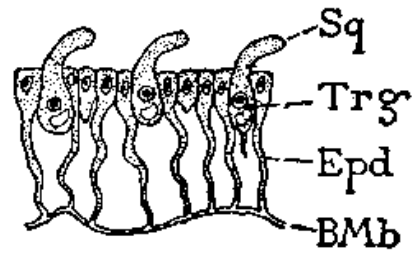


# Mechano receptors

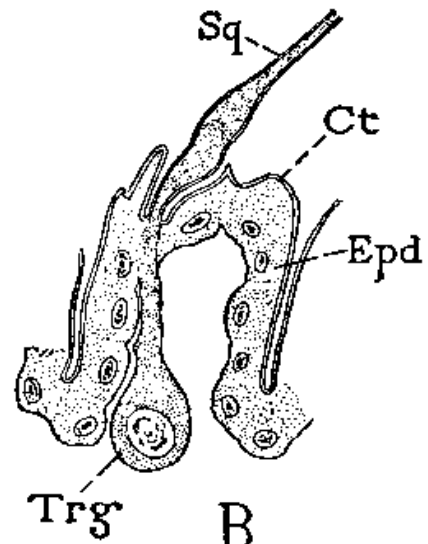


# Trichogen and Gland Cells in Larval Tubercle

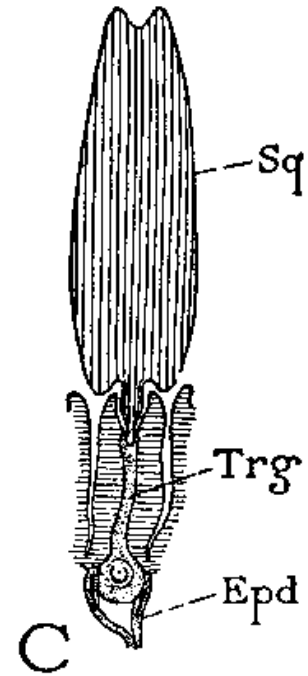




A



B

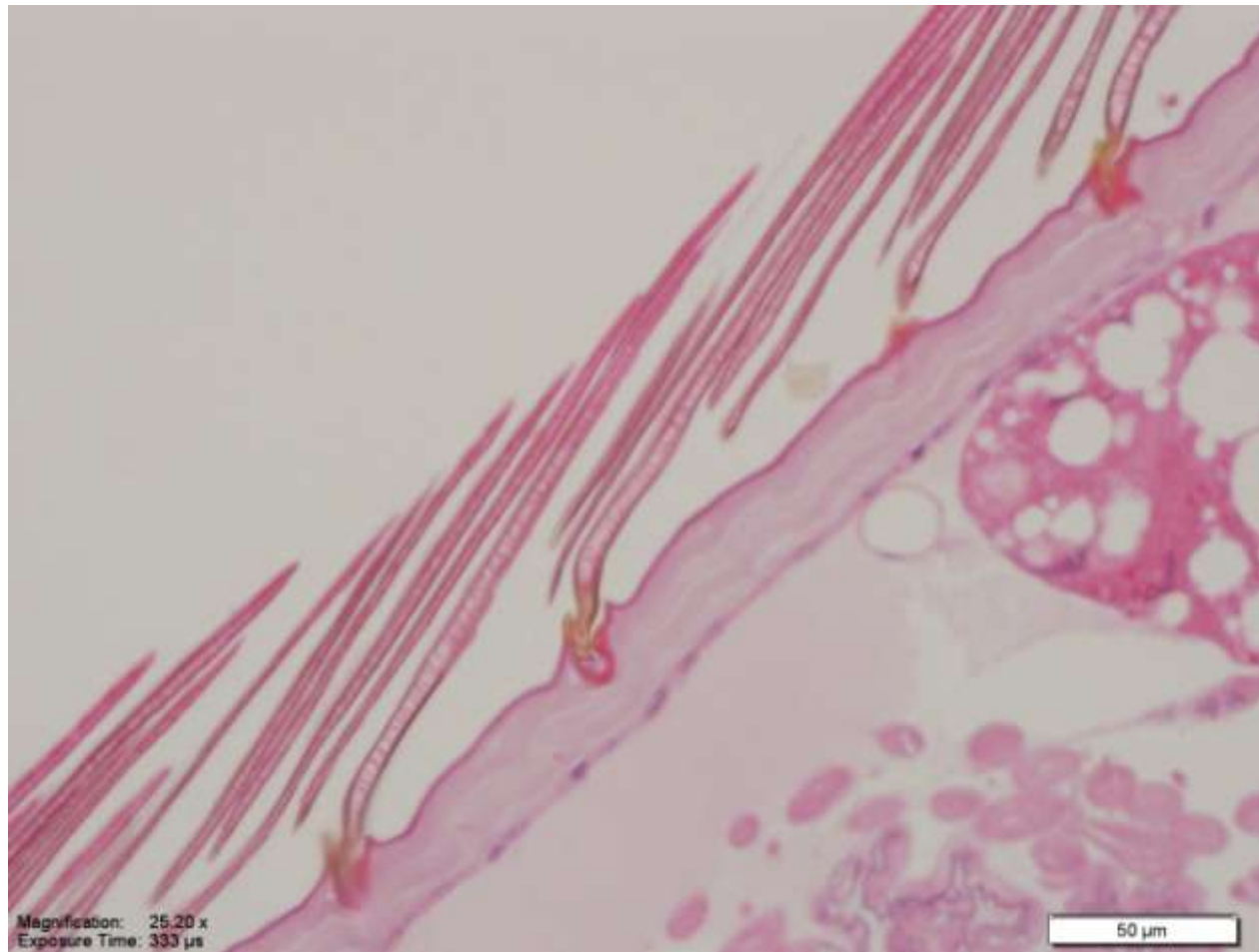


C



D

# Lepidopteral Scales



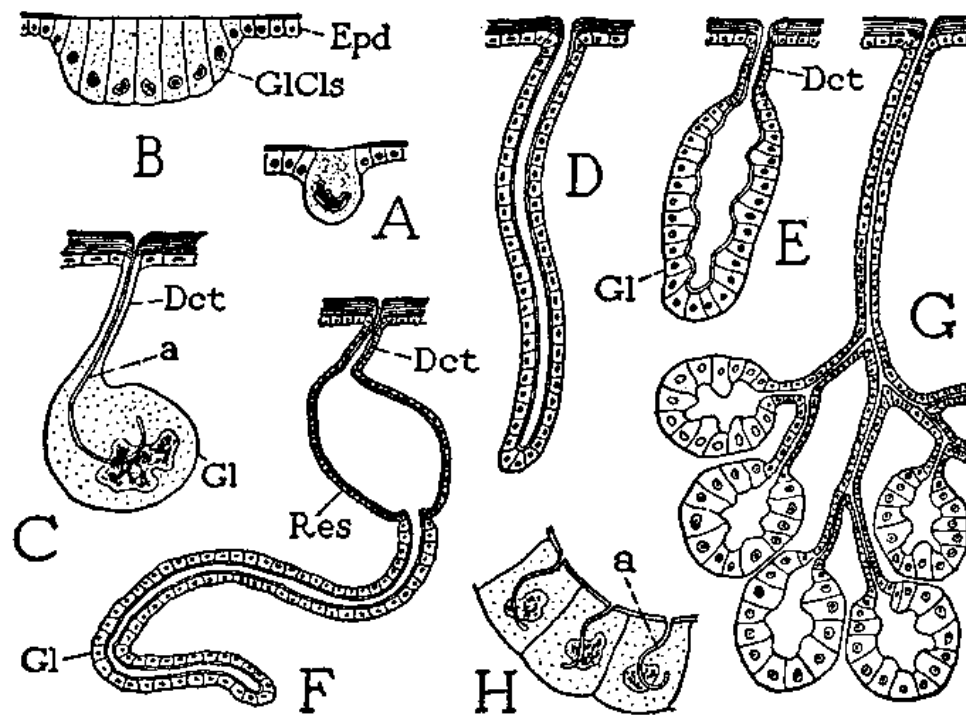


FIG. 32.—Various structural types of ectodermal glands, diagrammatic.

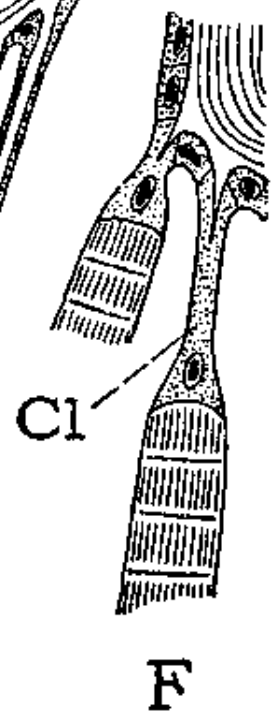
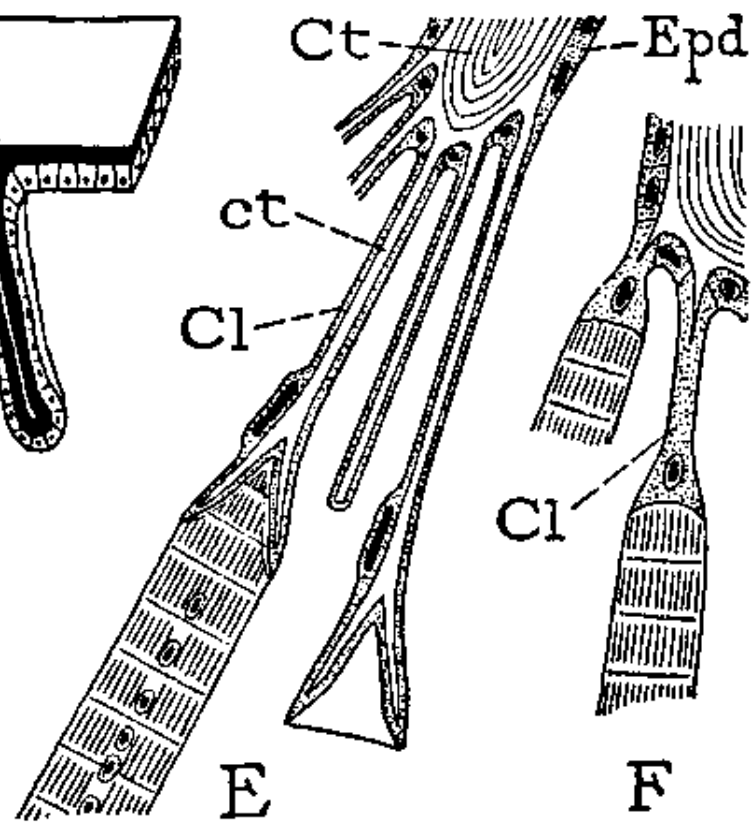
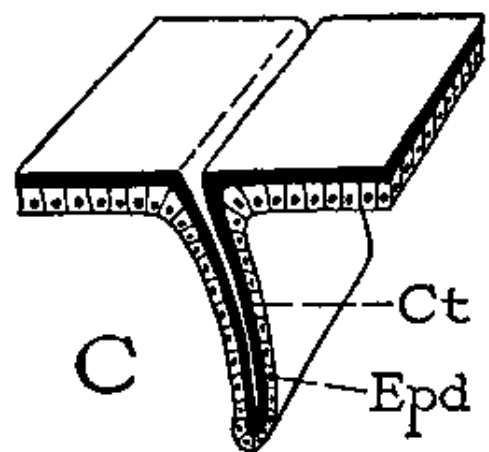
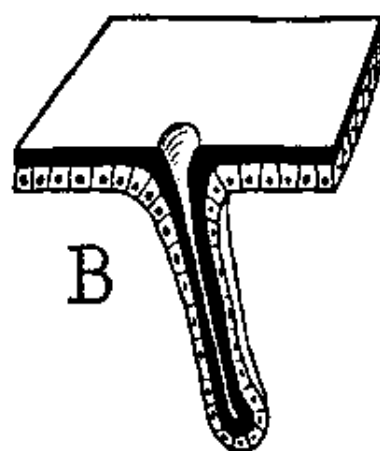
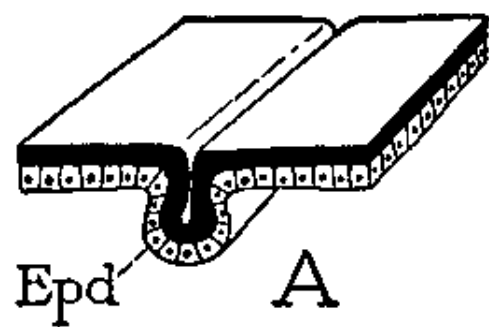
# Simple Integumental Gland



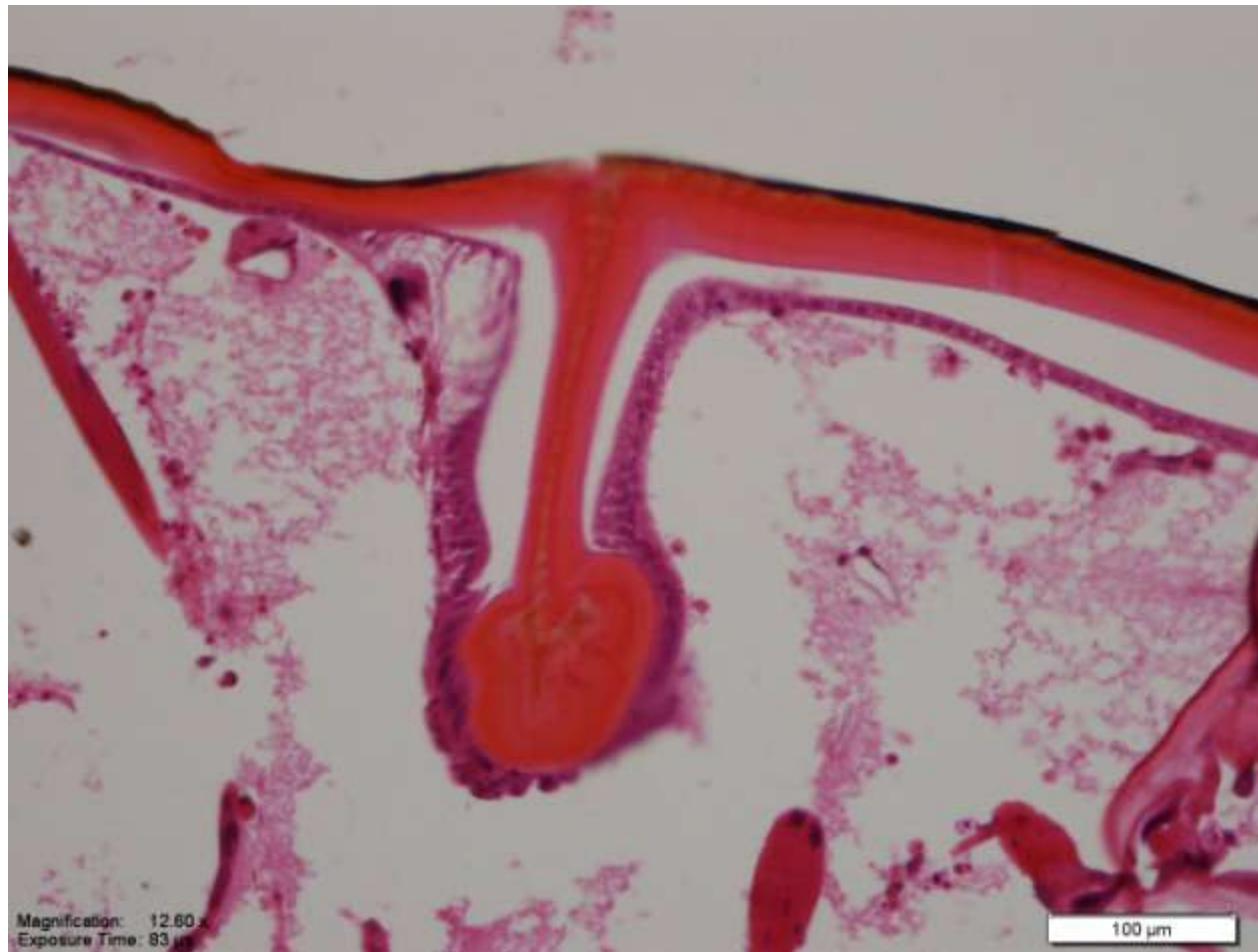


# Epidermal Gland

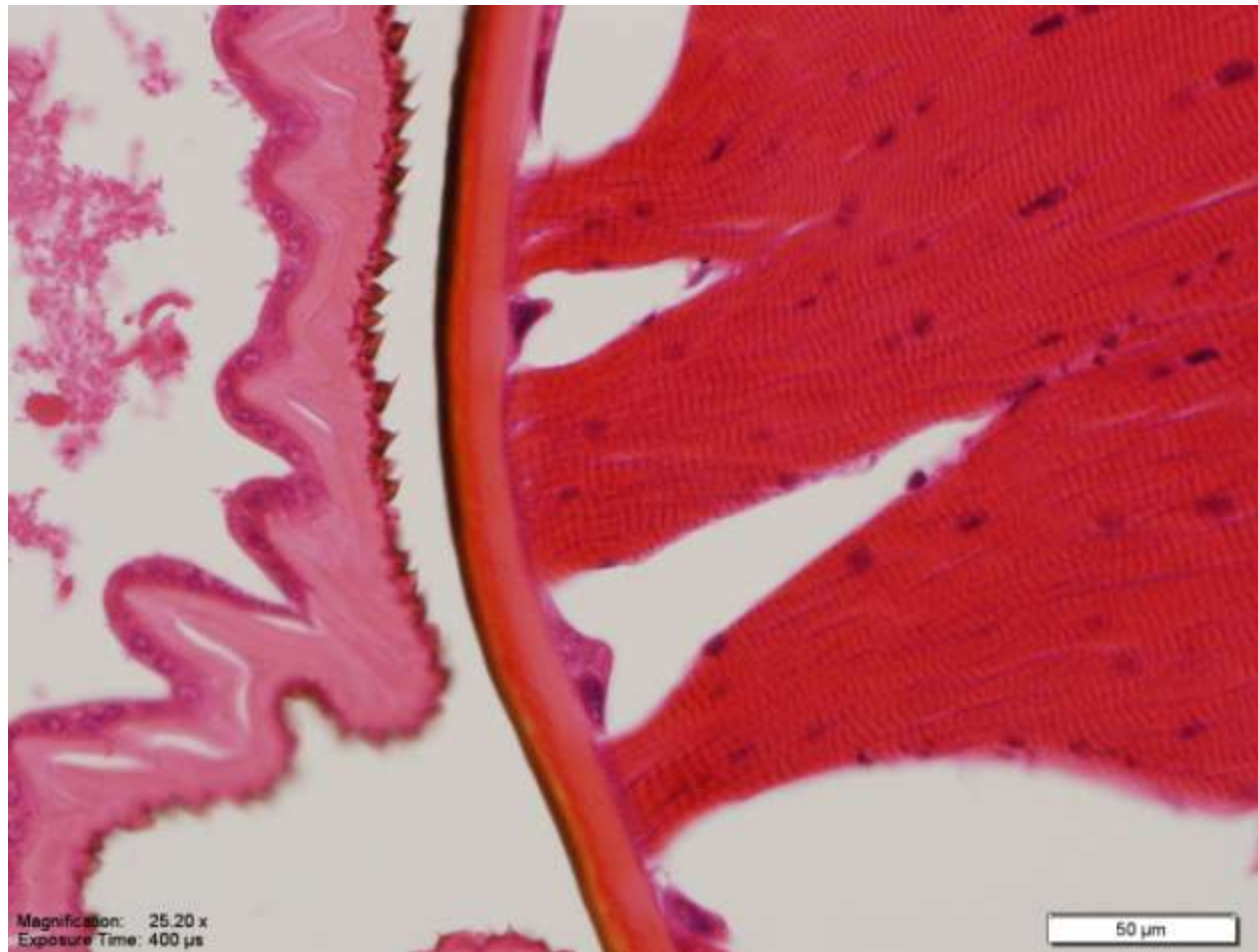




# Apodeme



# Muscle attachment to Cuticle



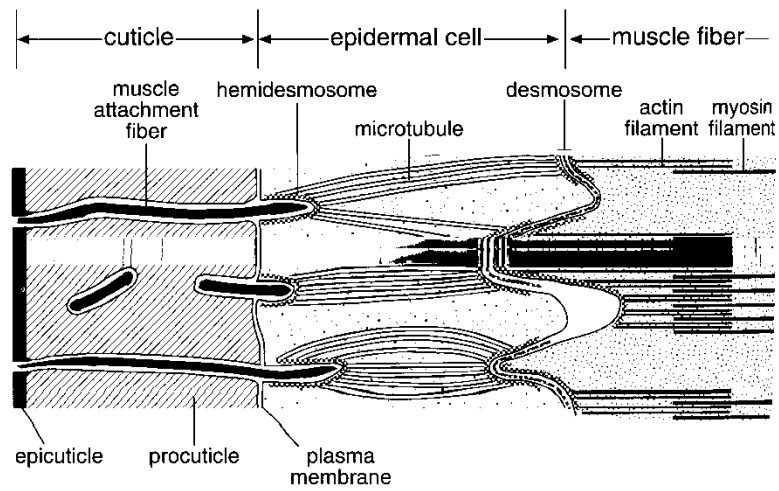


Fig. 10.5

# Molting (Apolysis) Epidermis in *G. incorrupta* larvae





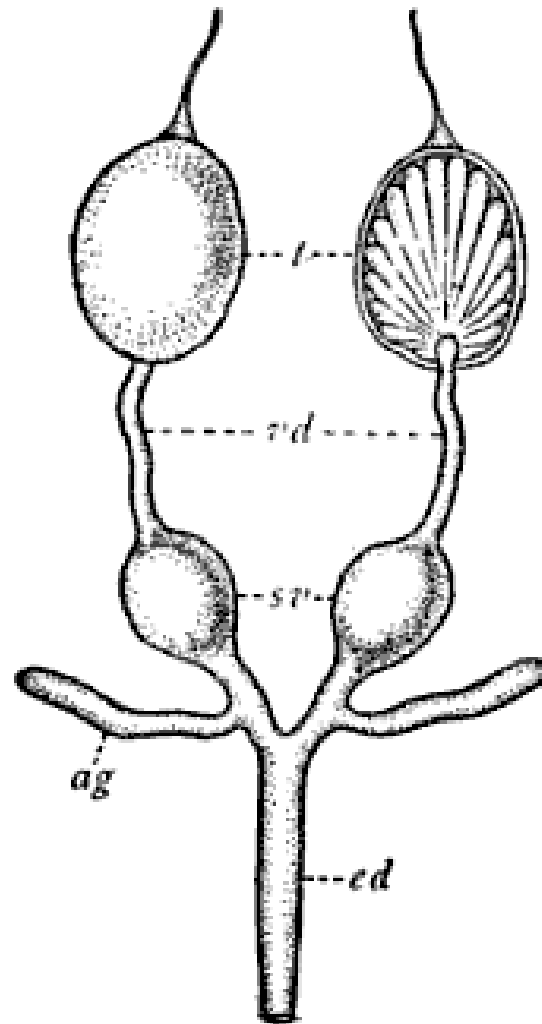
# Hardening the Pre-tanned Exocuticle



# Male Reproduction



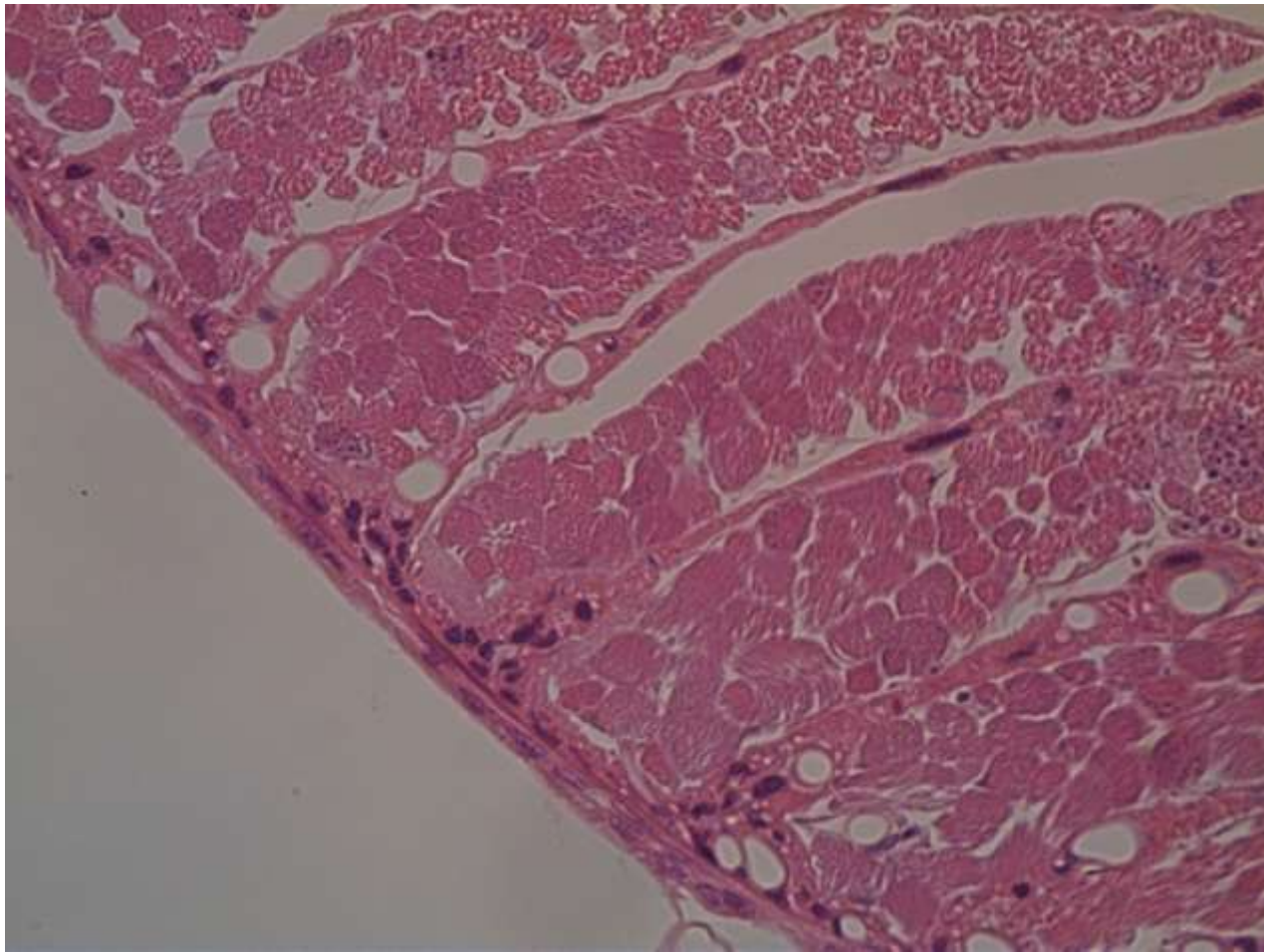
# Male Reproductive Tract



# Larval Testis



# Adult Testis

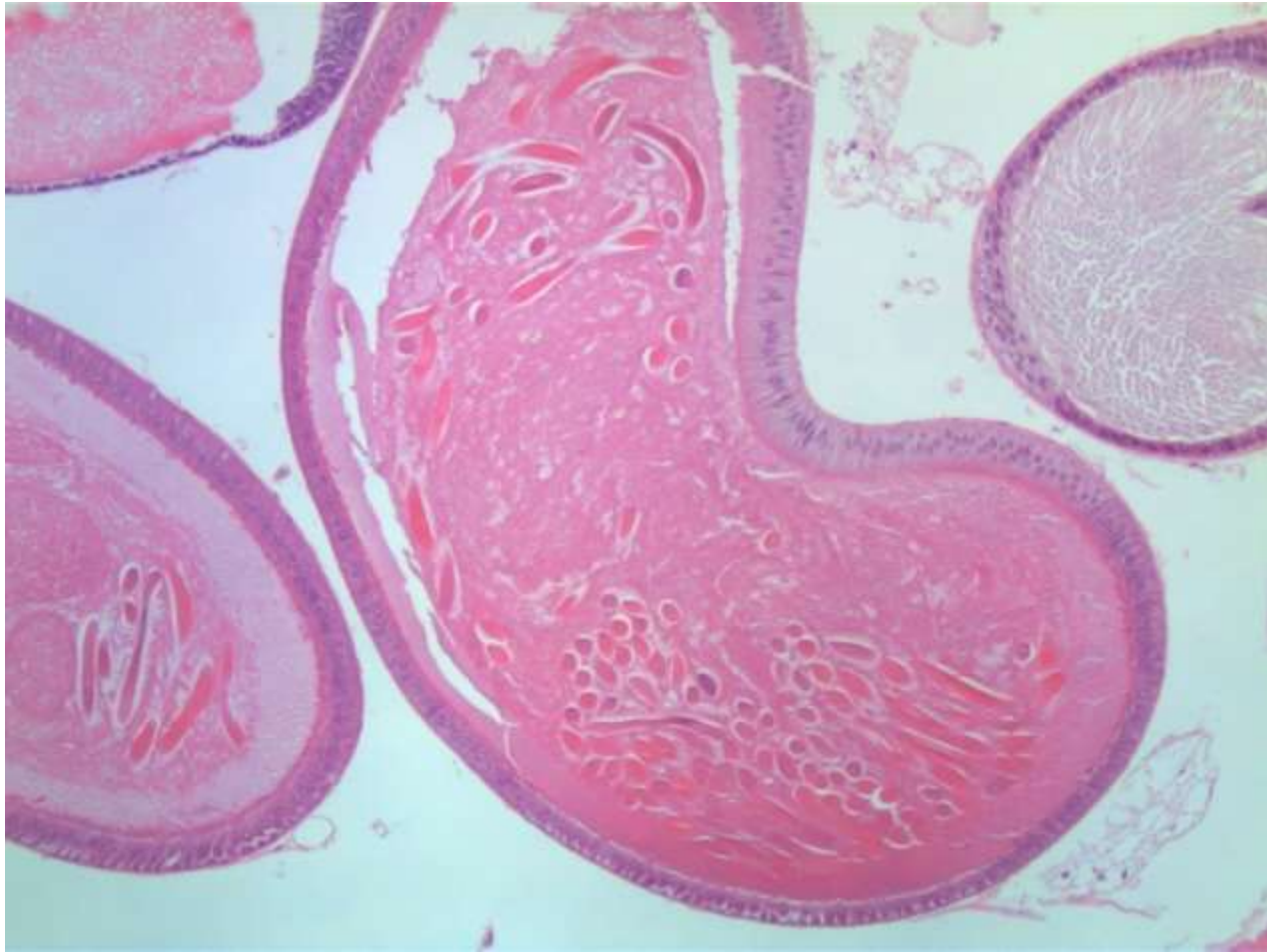


# Vas Deferens





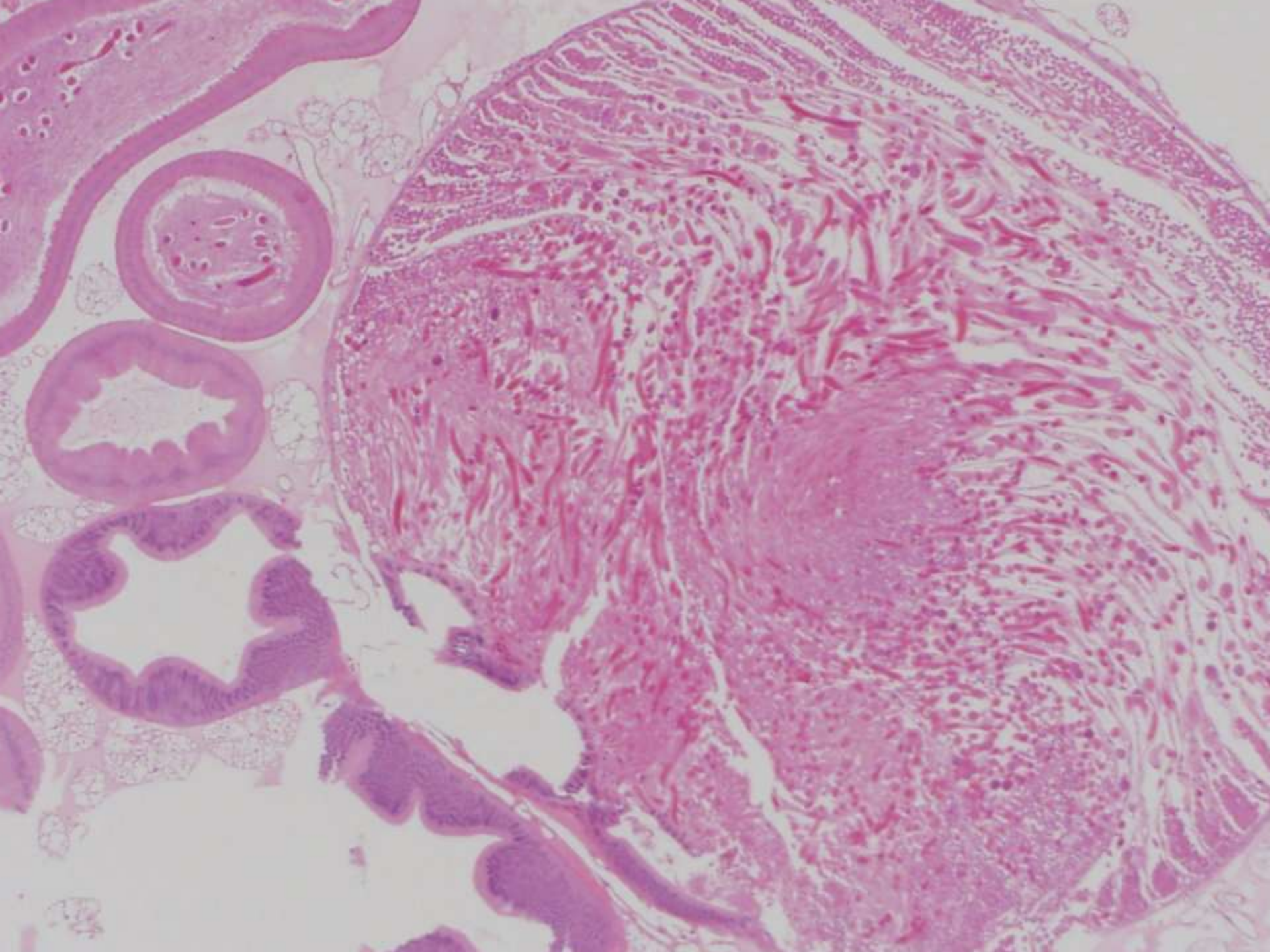
# Seminal Vesicle



# Accessory Gland



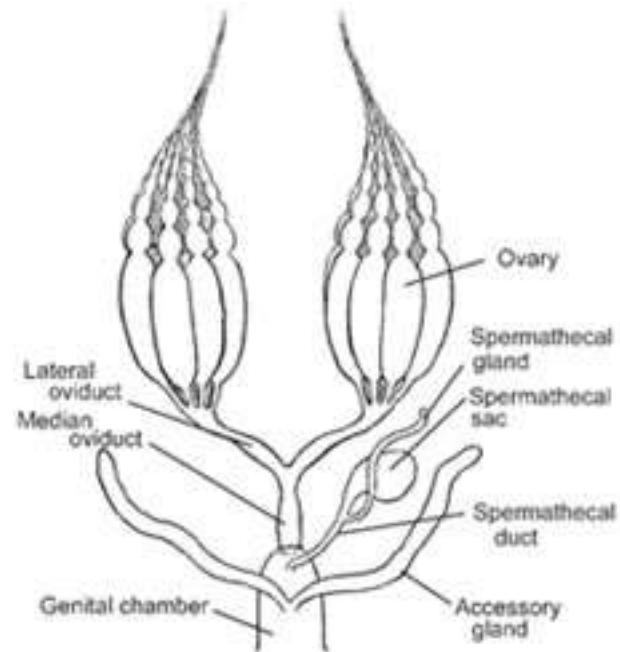




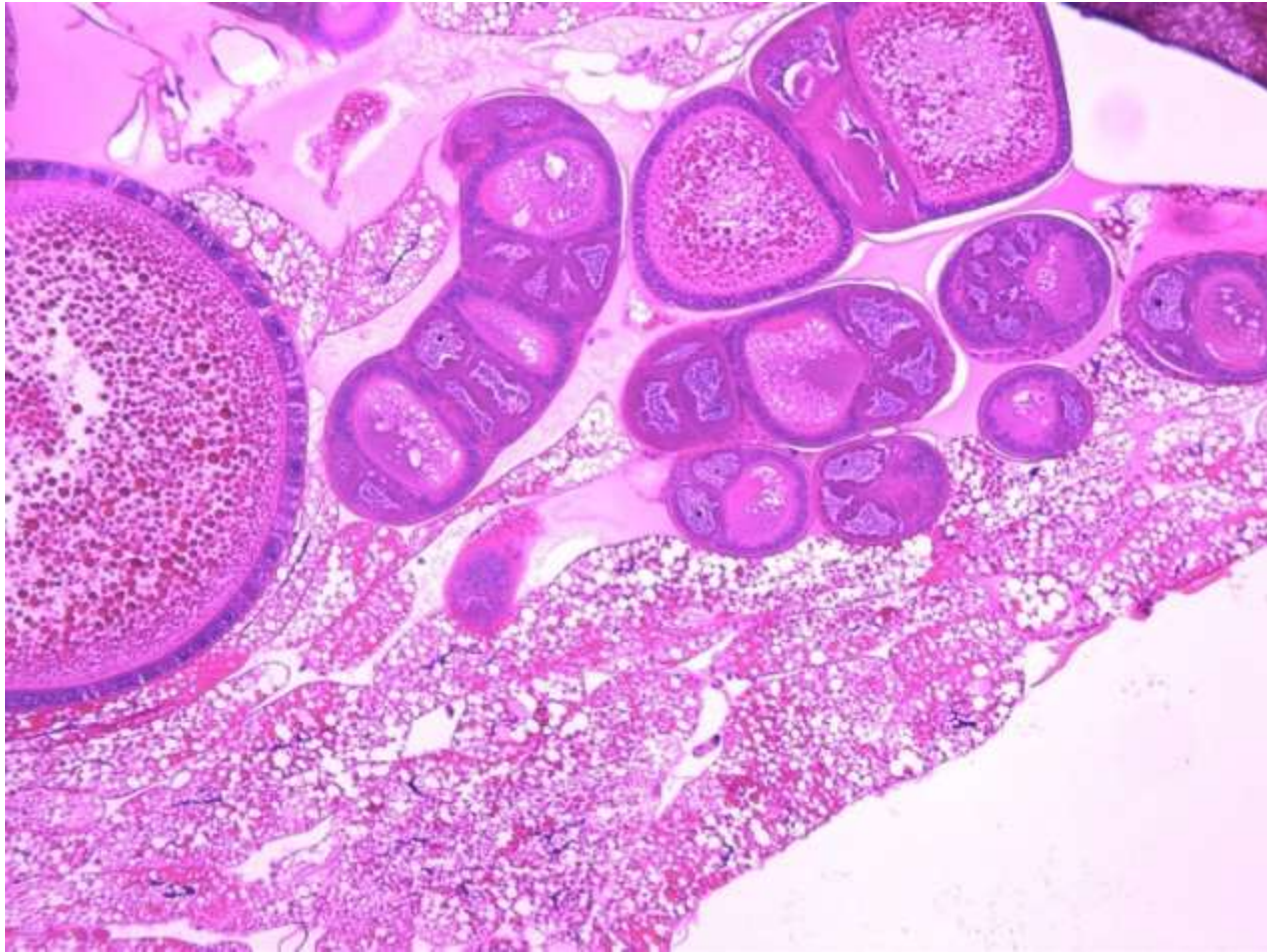
# Female Reproduction



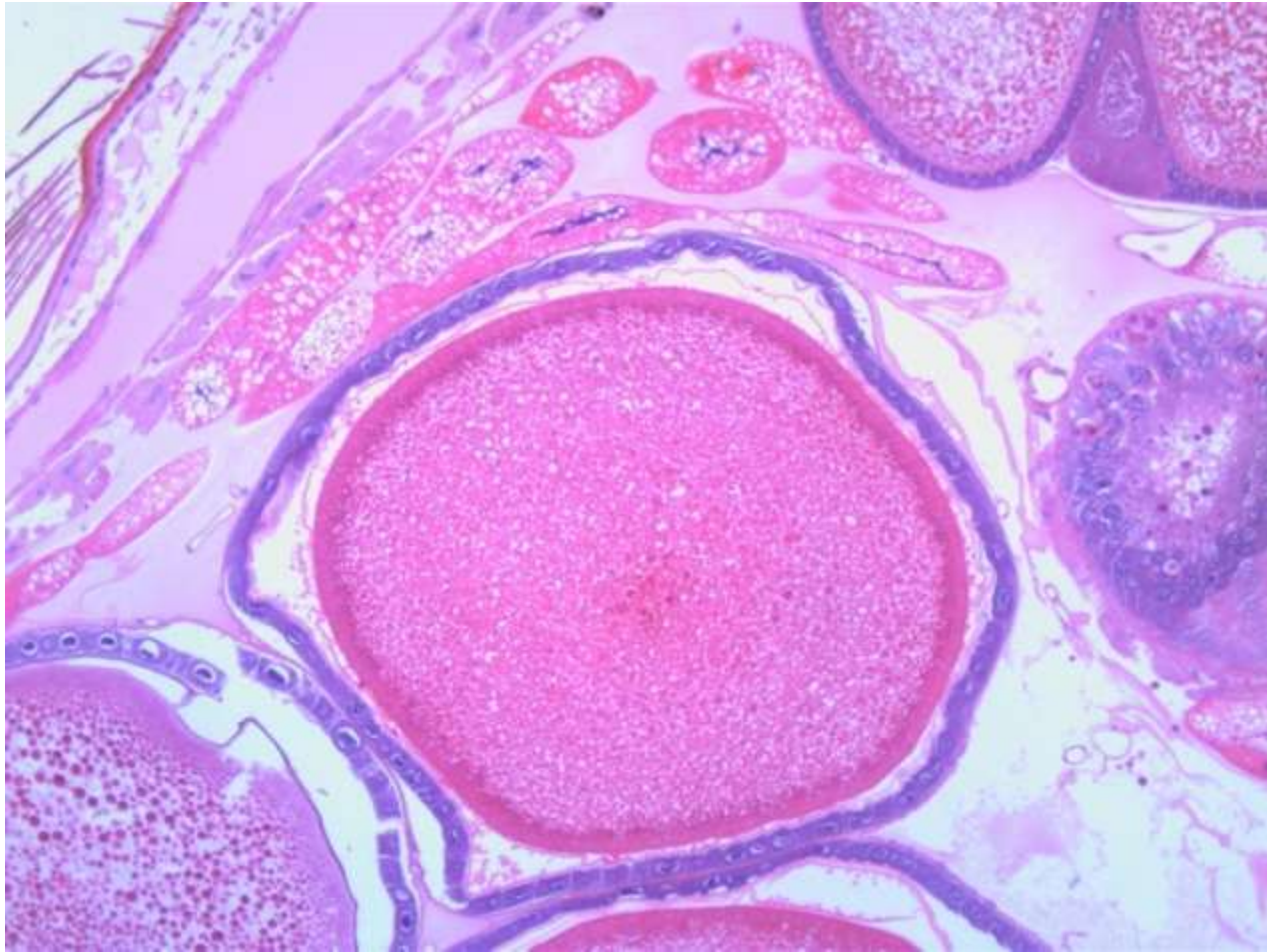
# Female Reproductive Tract



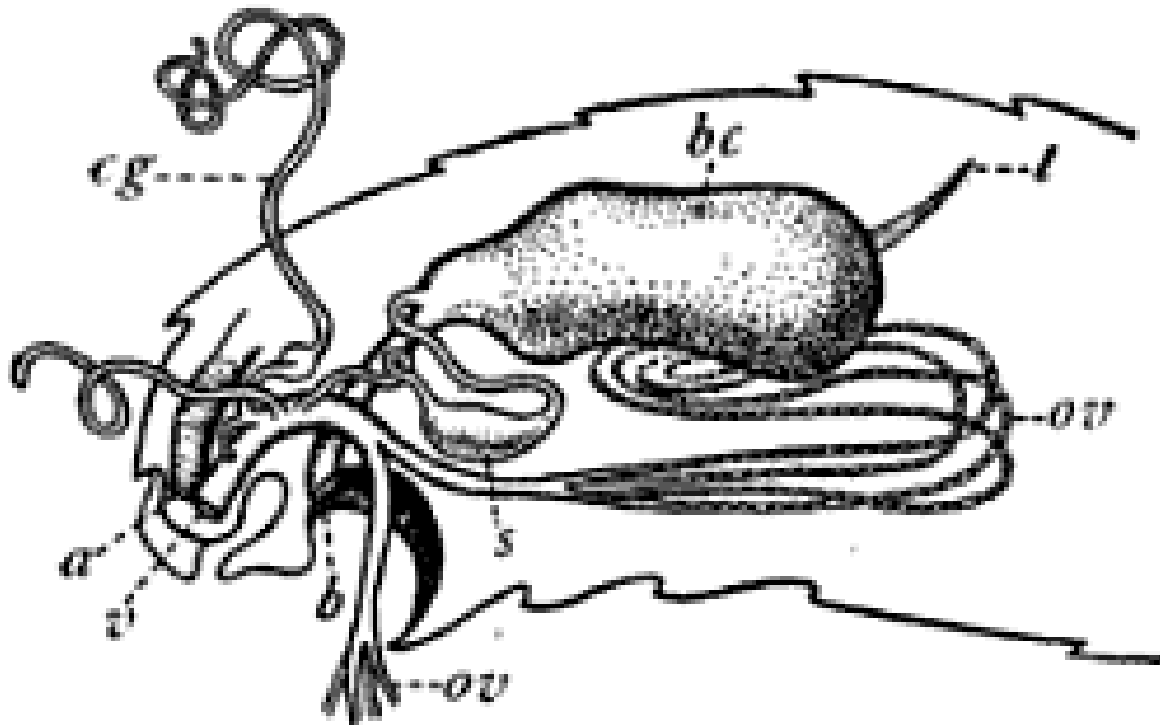
# Ovariole



# Maturing Ova

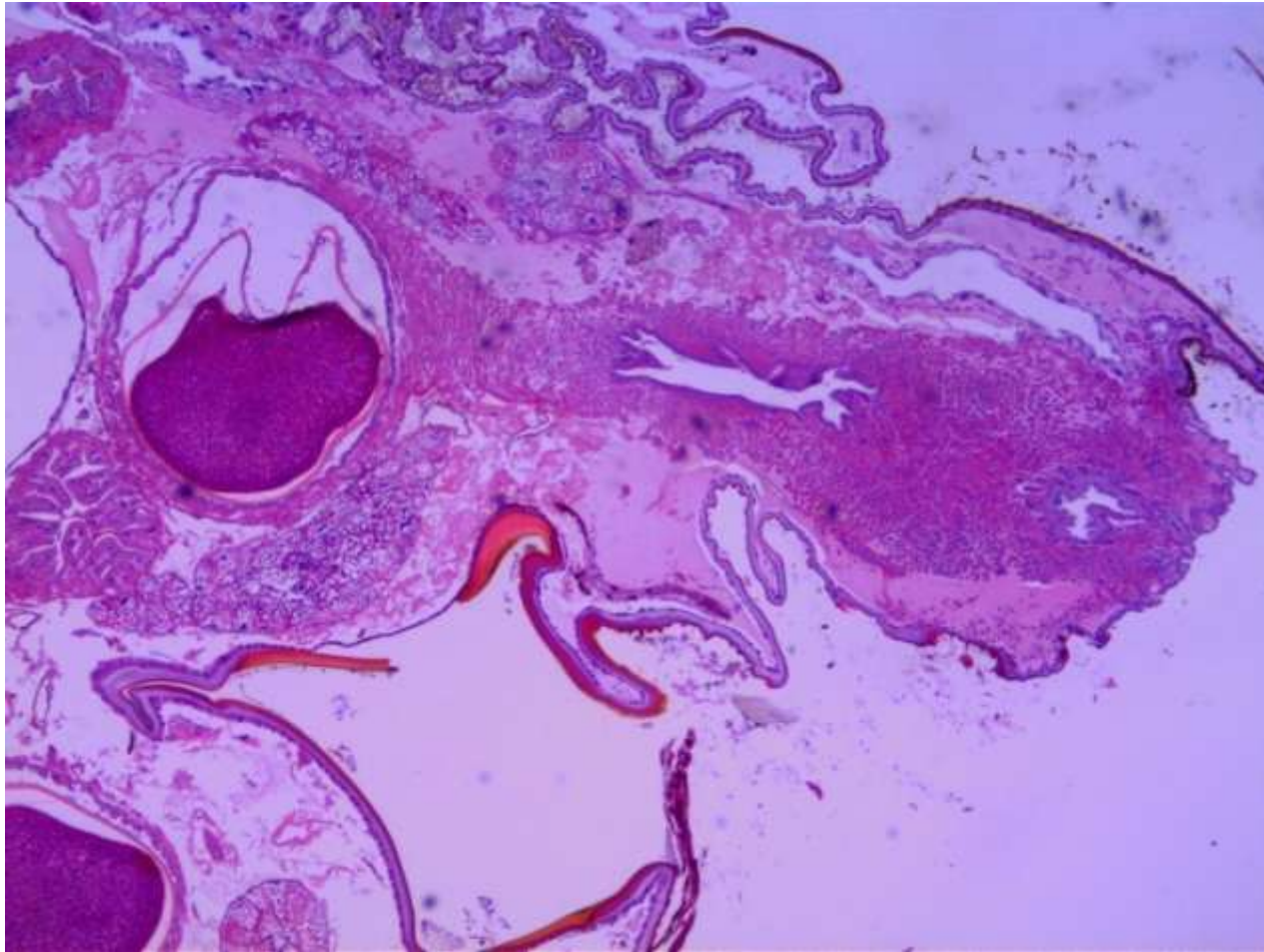


# Female Reproductive Tract





# Ostium Copulatrix and Vagina



# Arctiid Ova



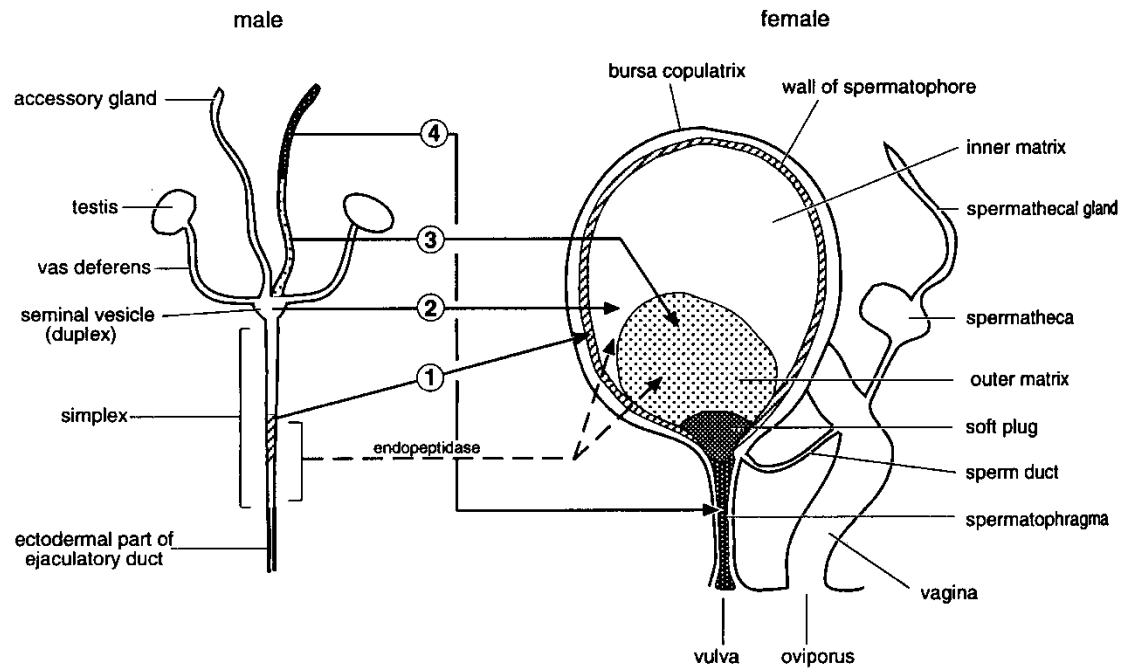
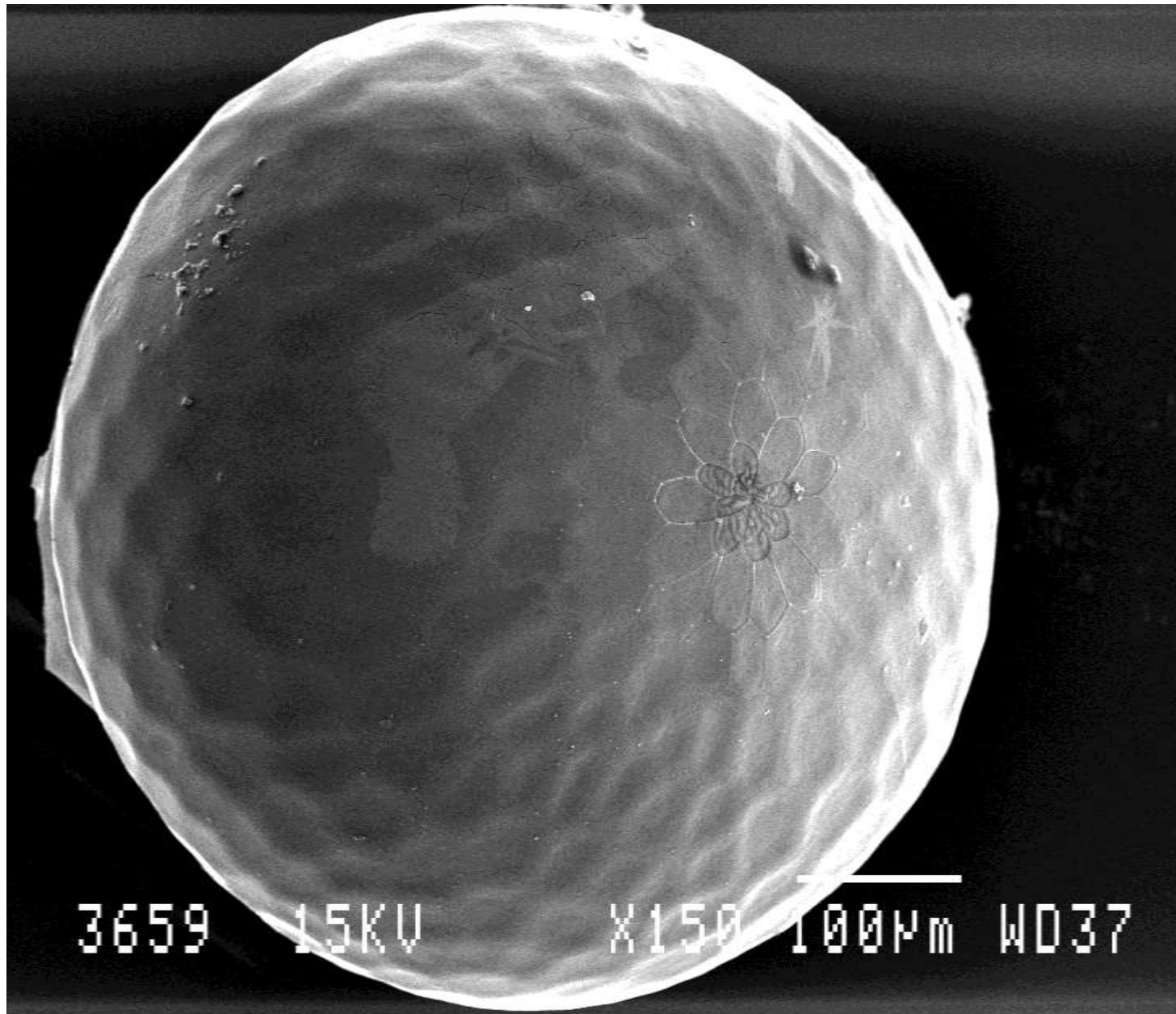
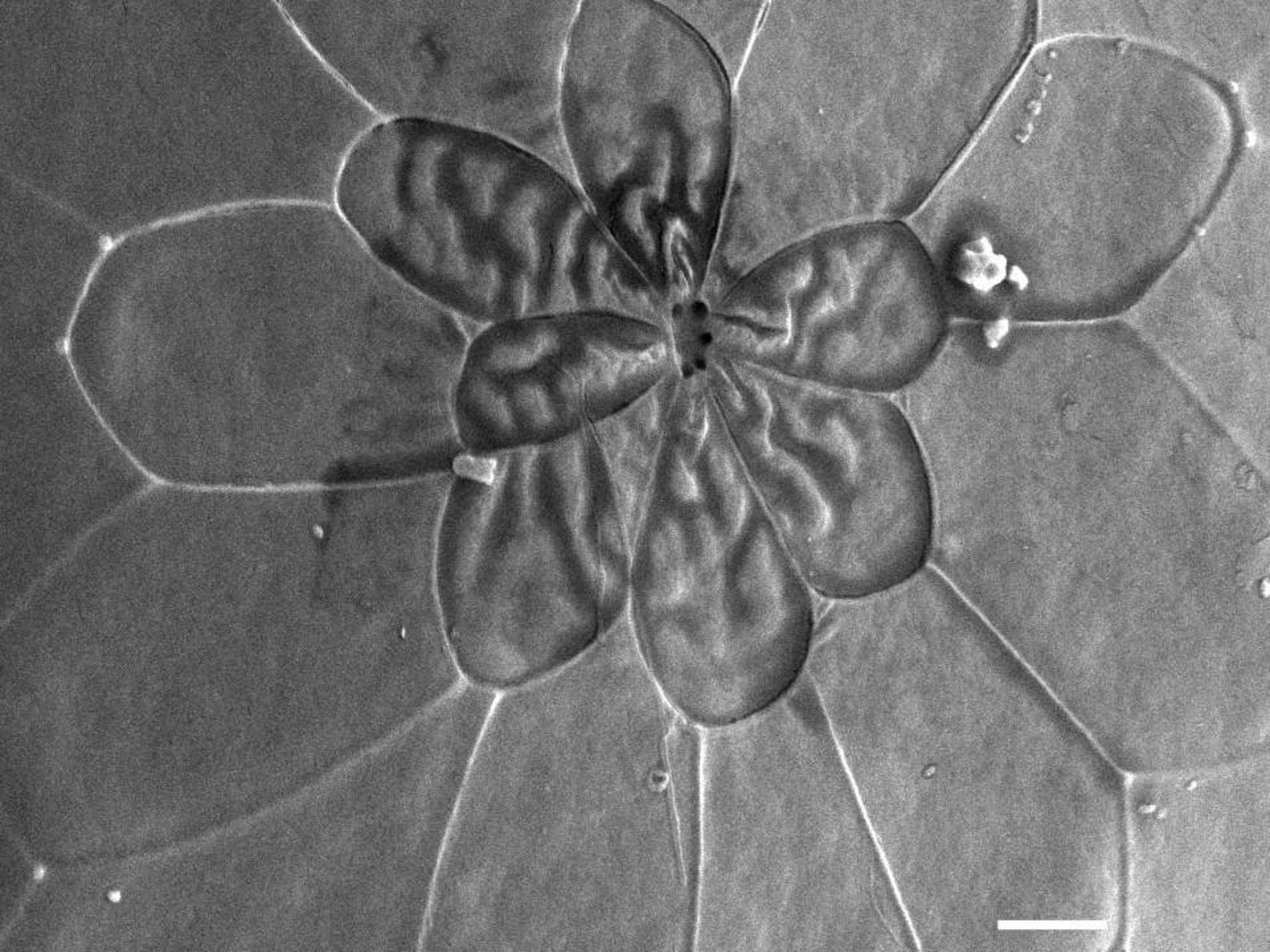


Fig. 12.14

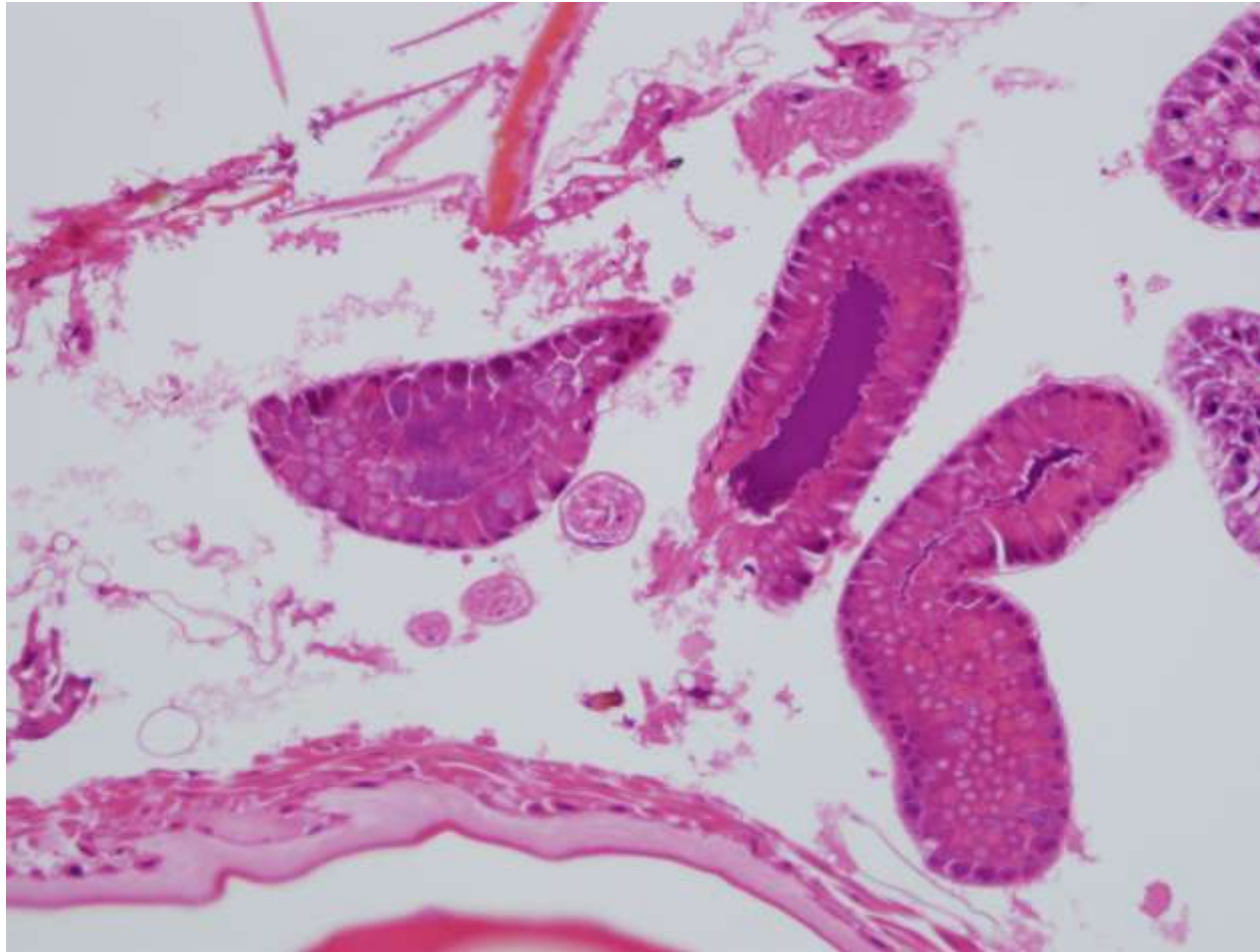
*Crambidia cephalica*



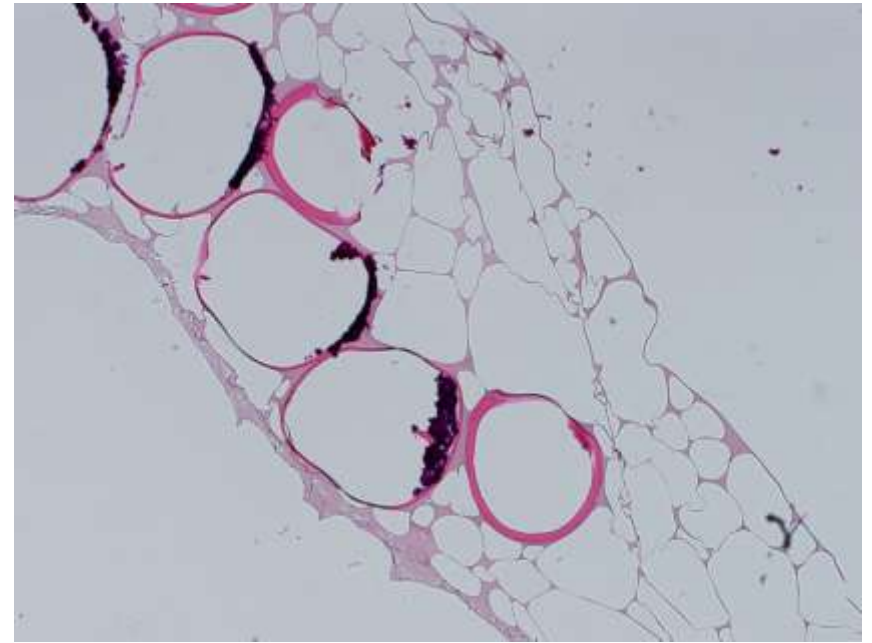
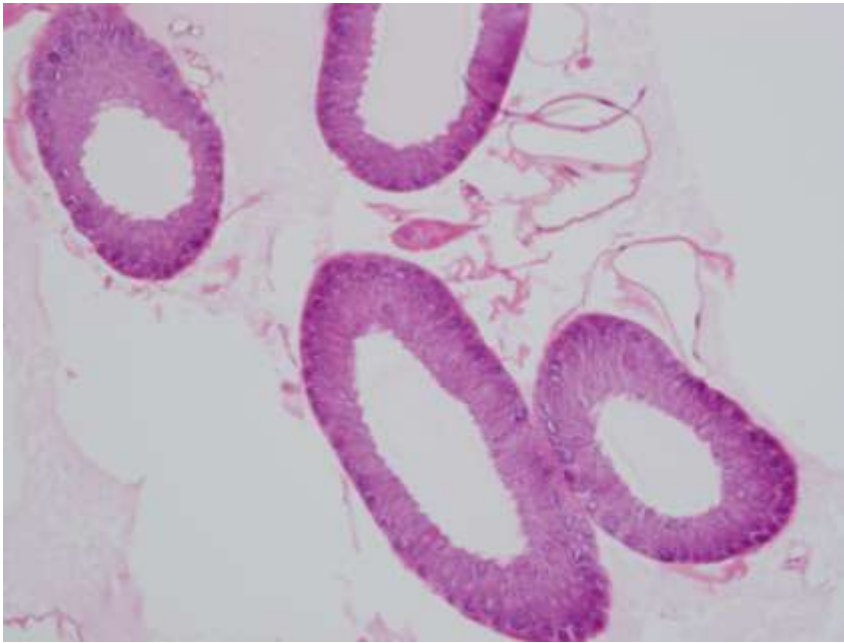




# H. Permaculata Accessory Glands



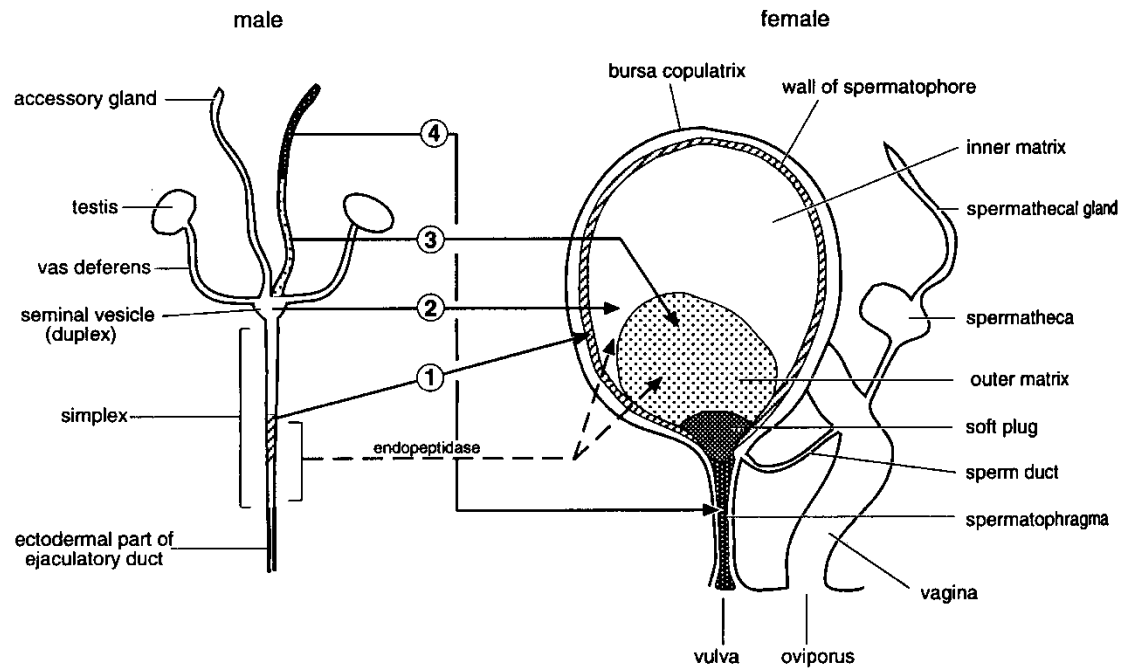
# Female Accessory Glands in Malacosoma





# Malacosoma ova covered with spumaline





#### reactions in spermatophore

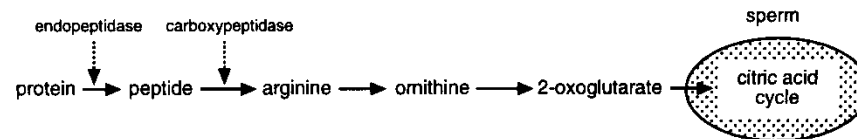
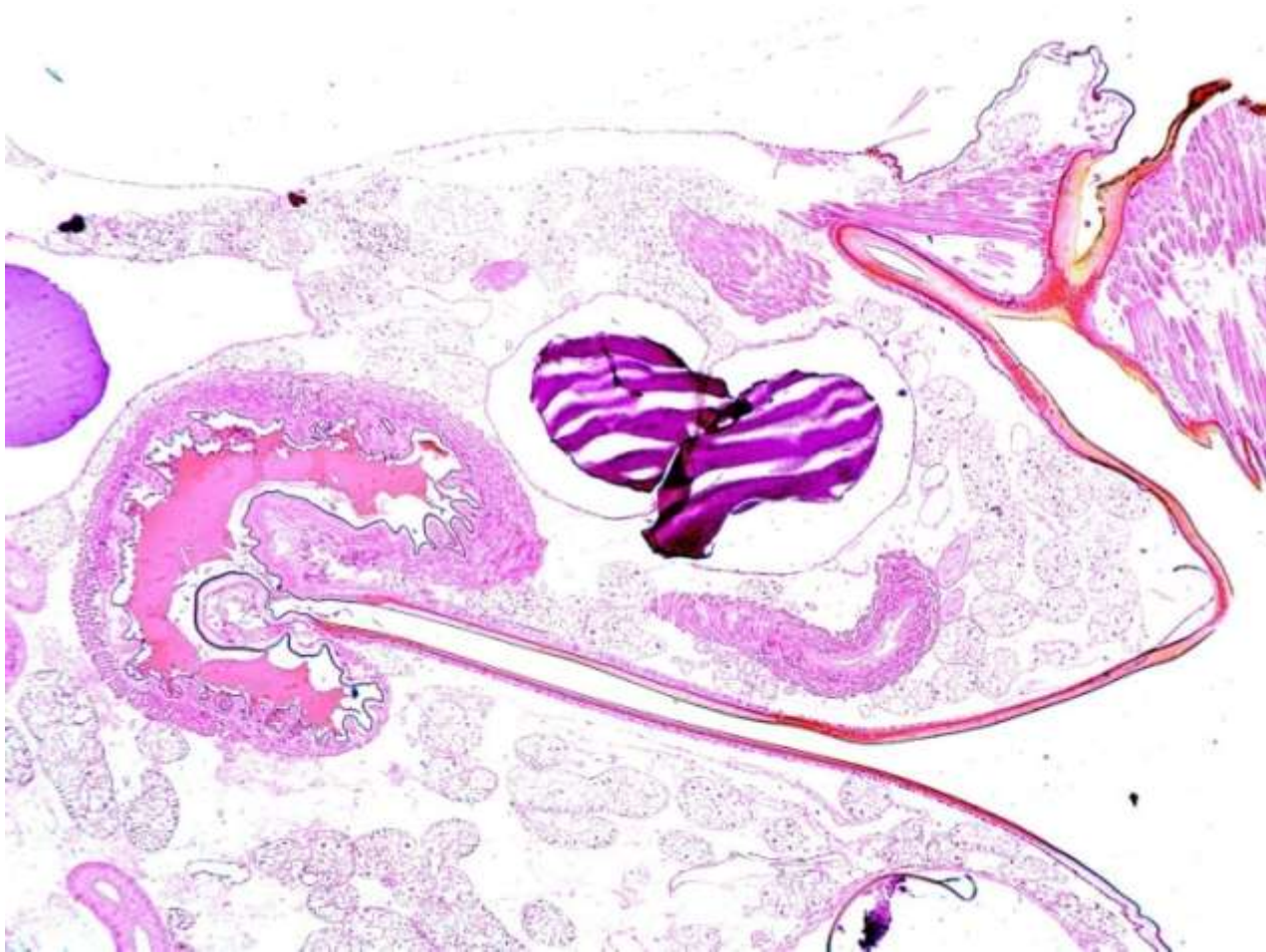


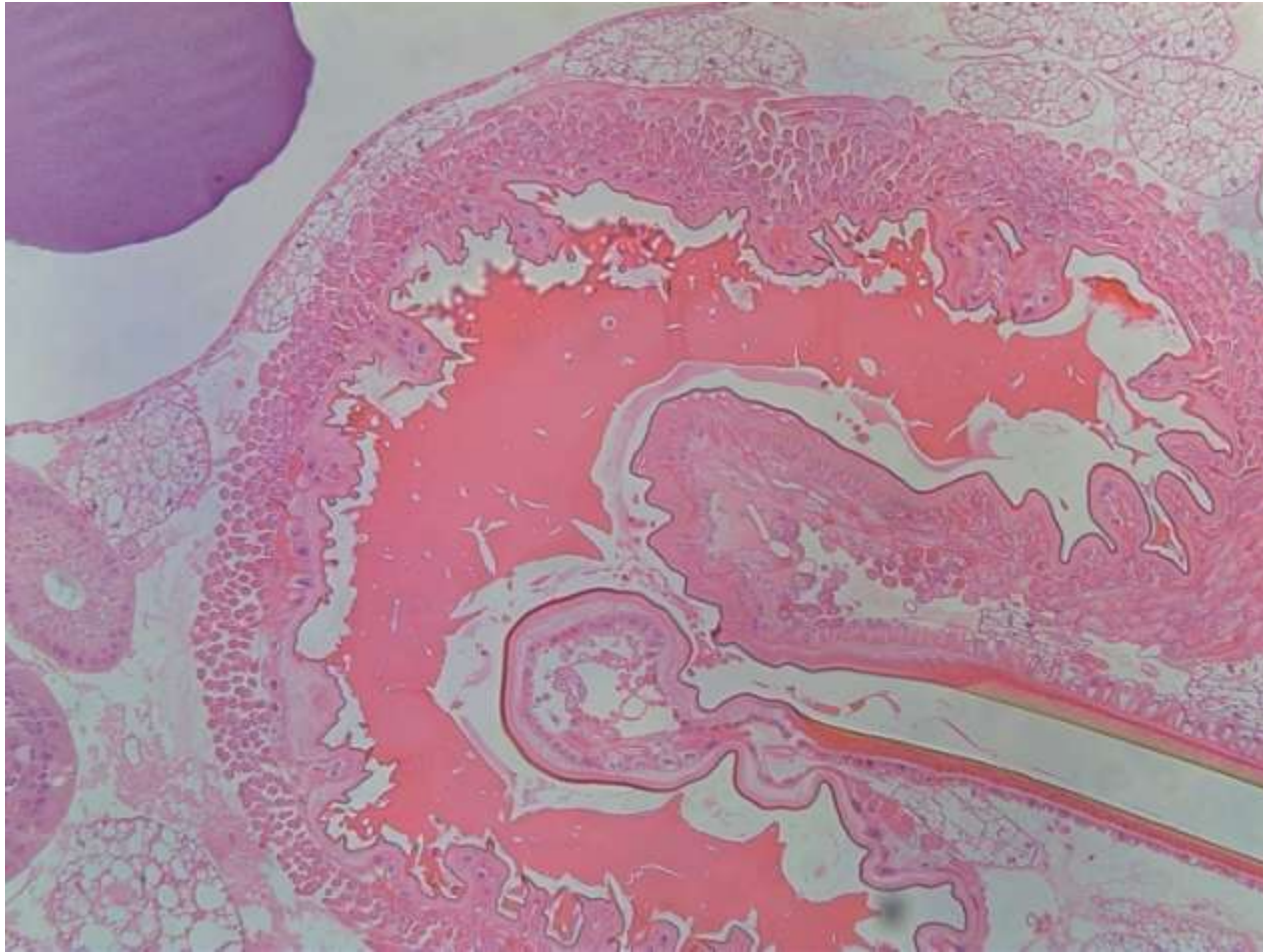
Fig. 12.14

# Ostium copulatrix



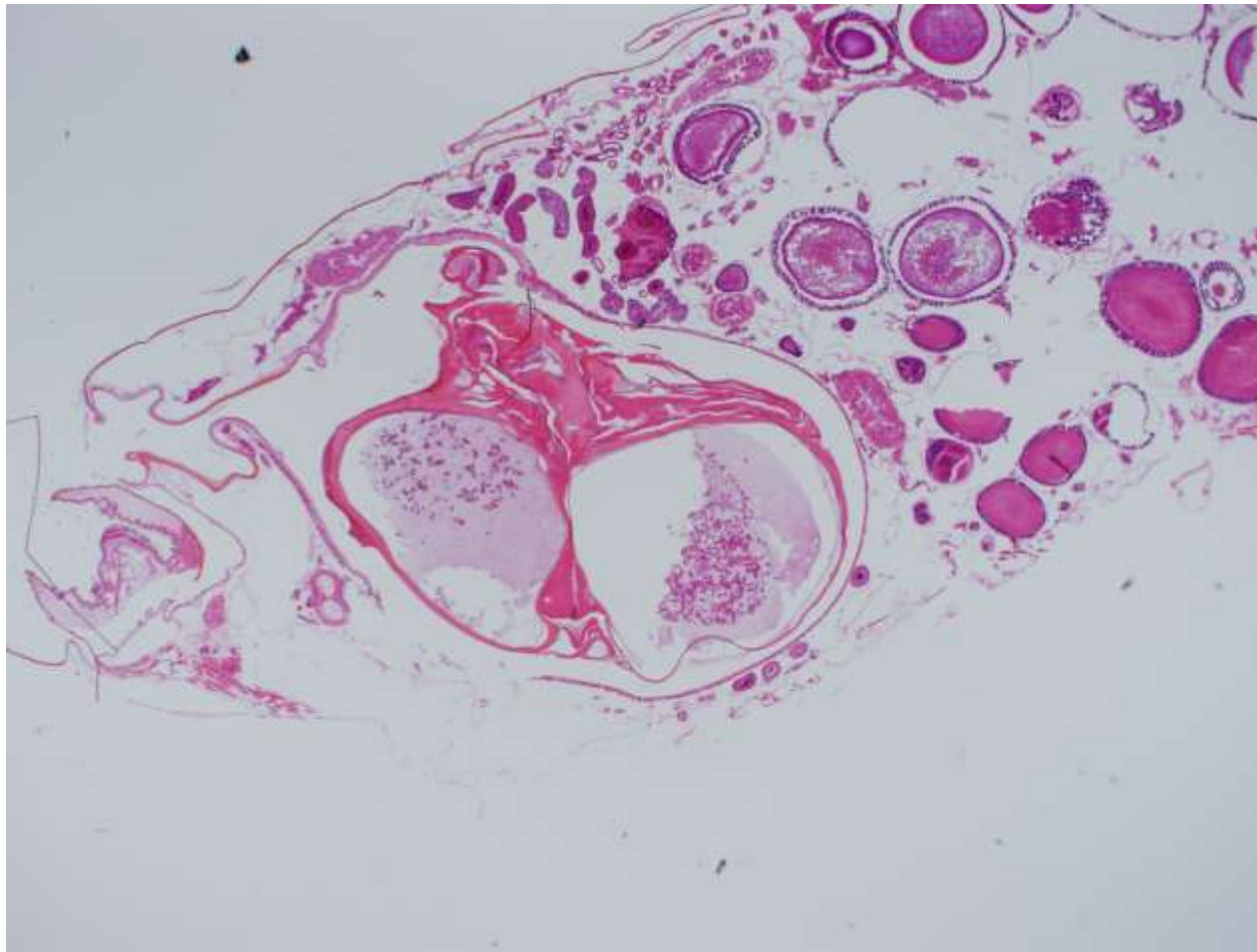


# Bursa Copularix

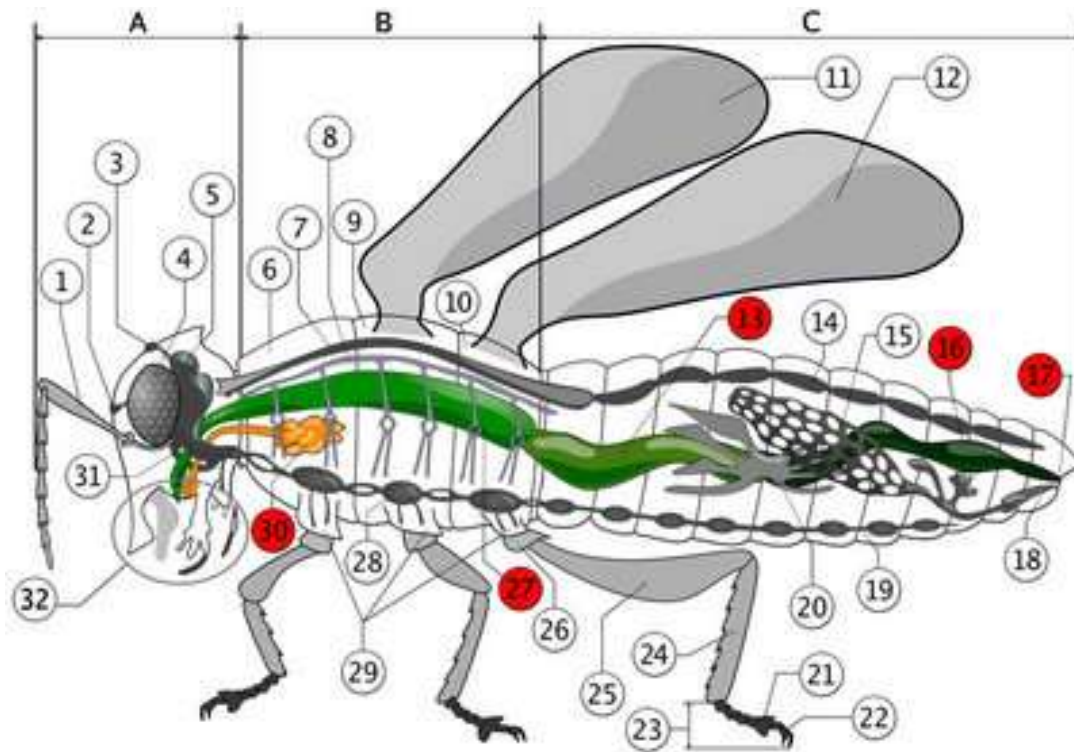




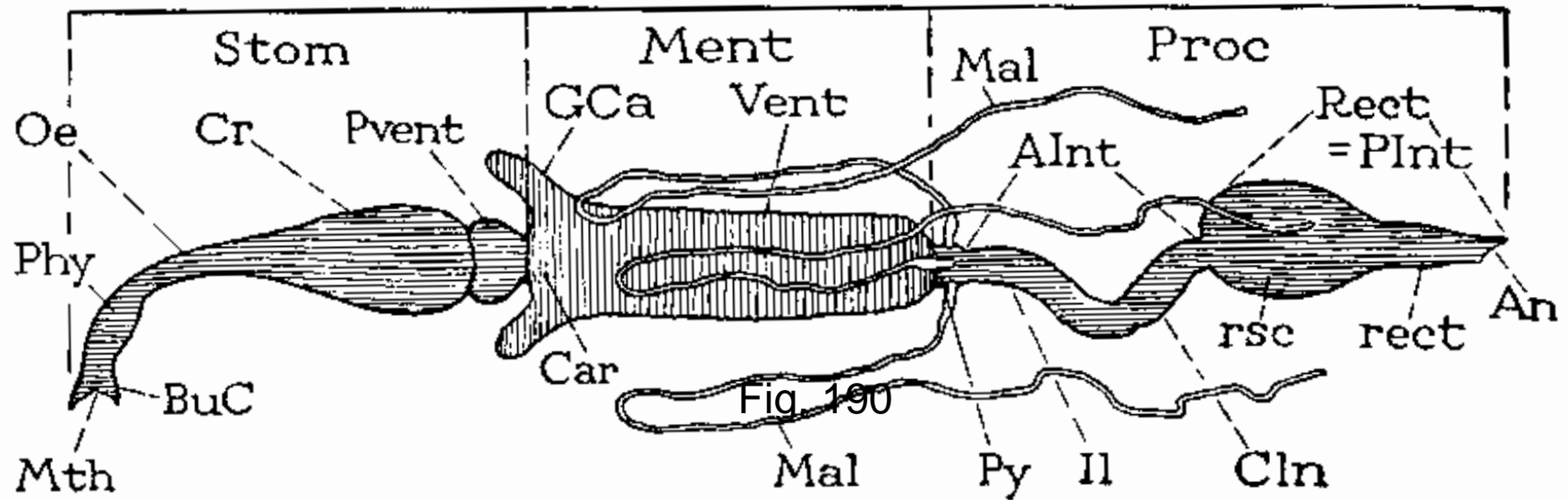
# Spermatophore in Bursa Copulatrix



# Gastrointestinal System



# Insect Gastrointestinal System



# Larval GI Tract

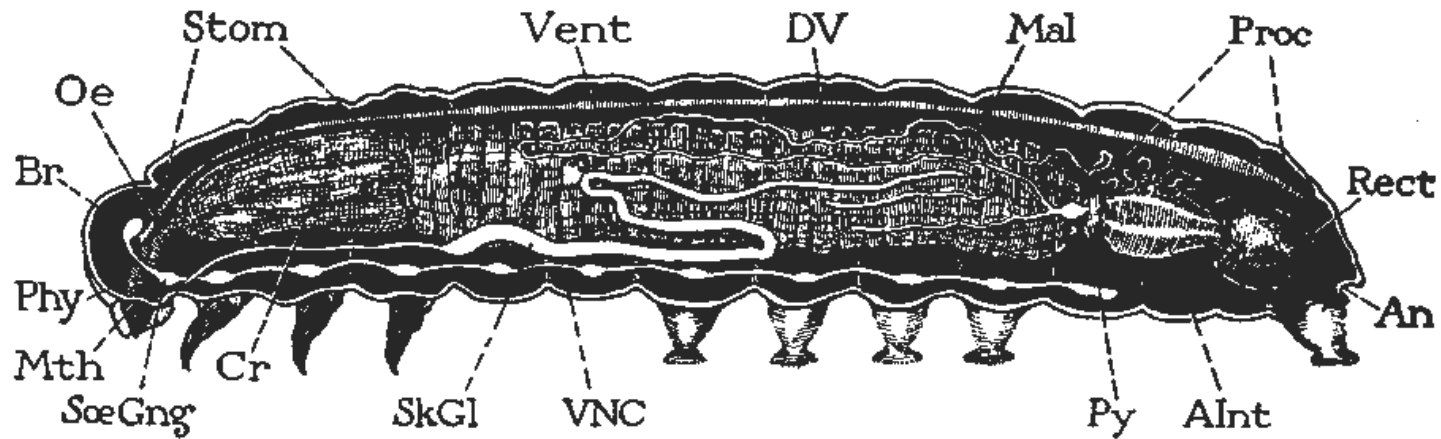


Fig. 196

# Foregut (Stomodeum)

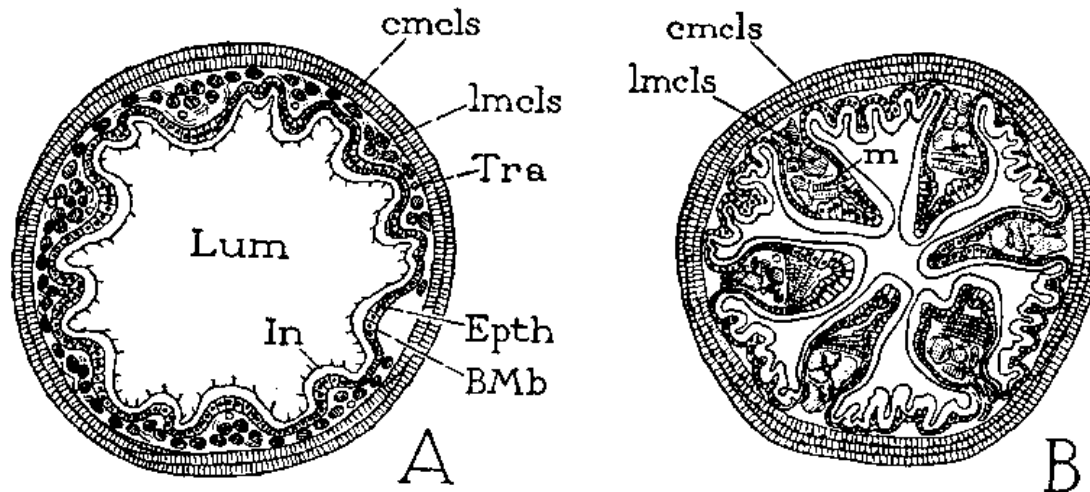
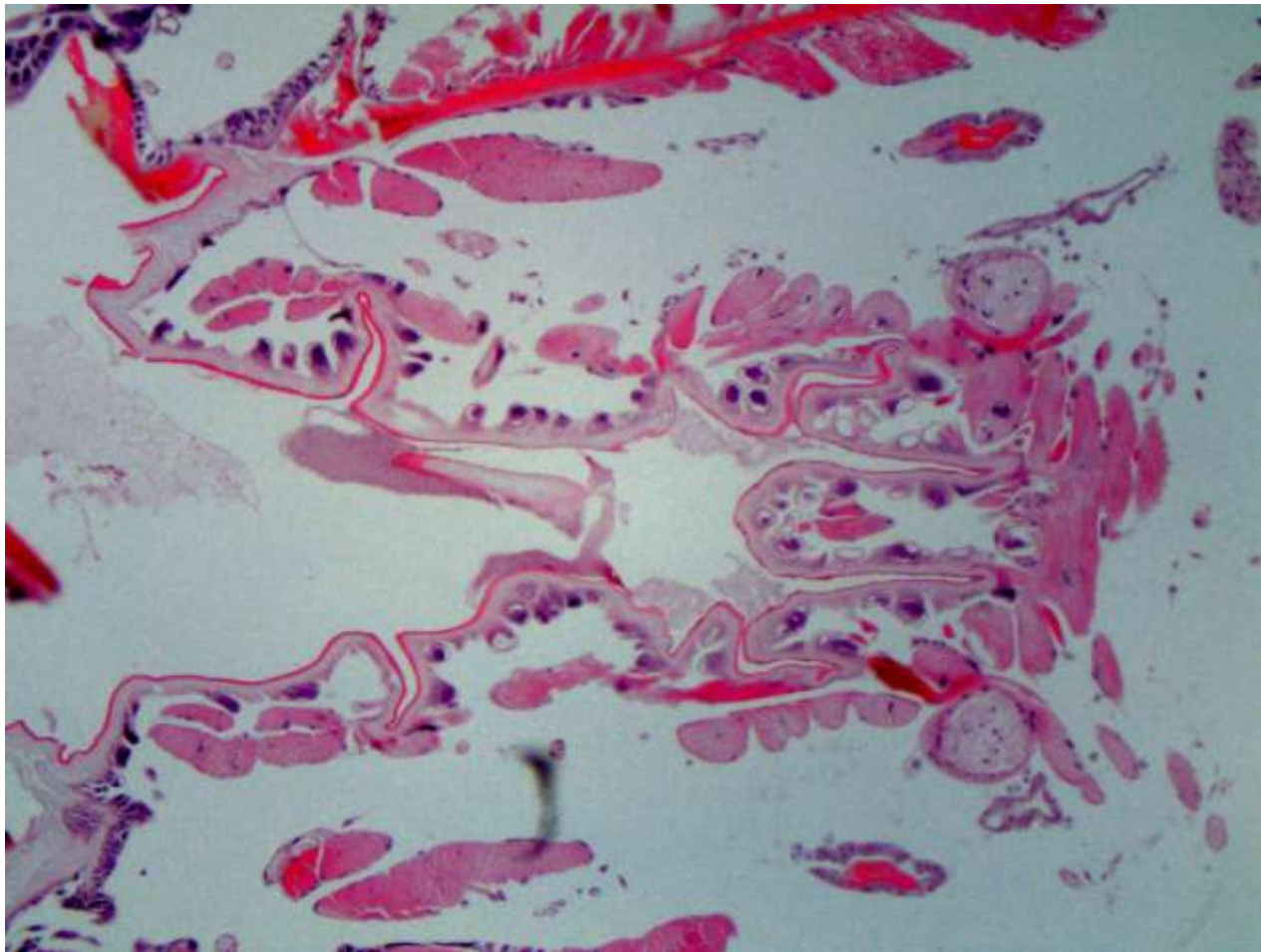


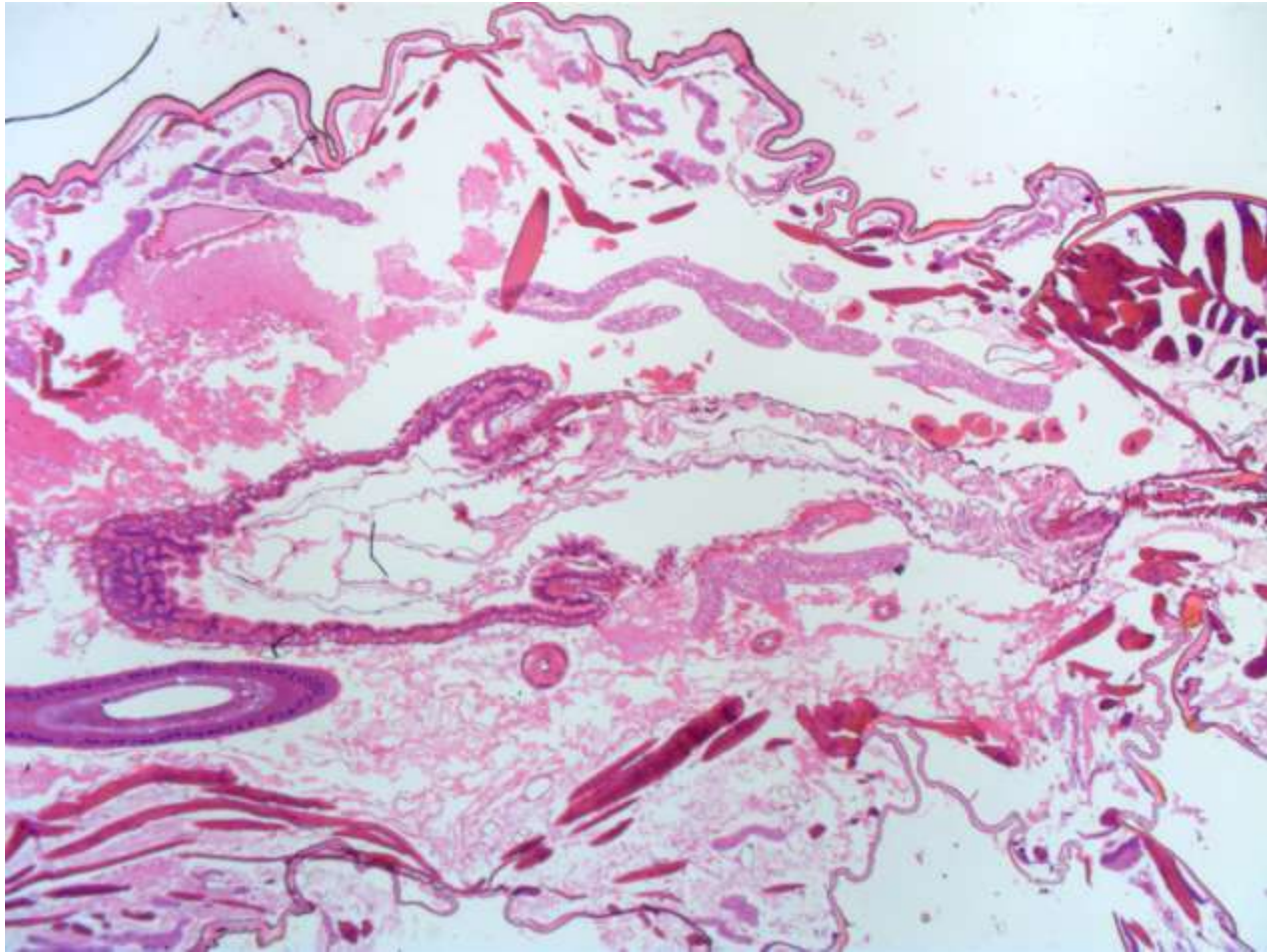
Fig. 191

# Noctuid Larval Buccal Cavity



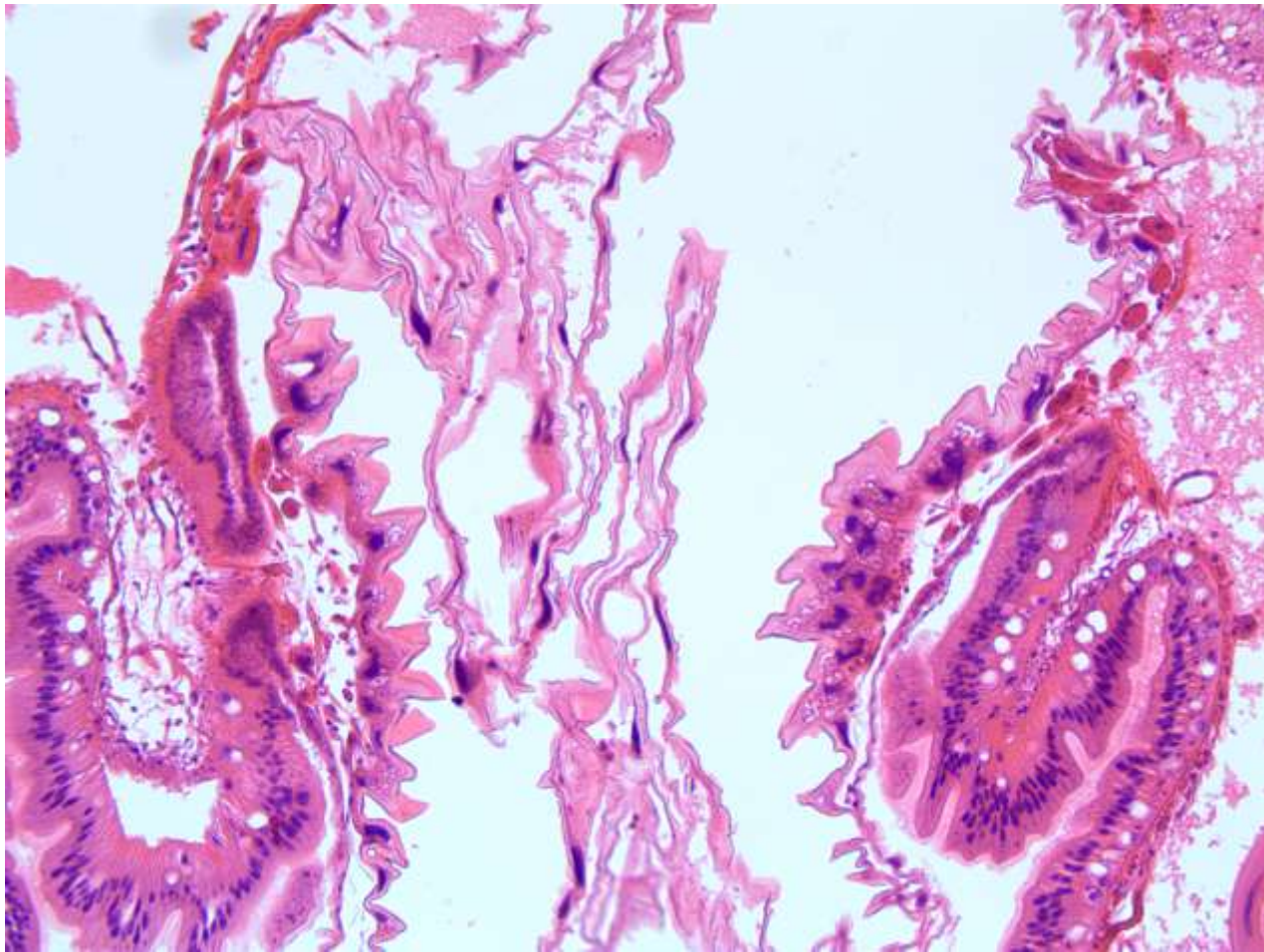


# Foregut-Midgut

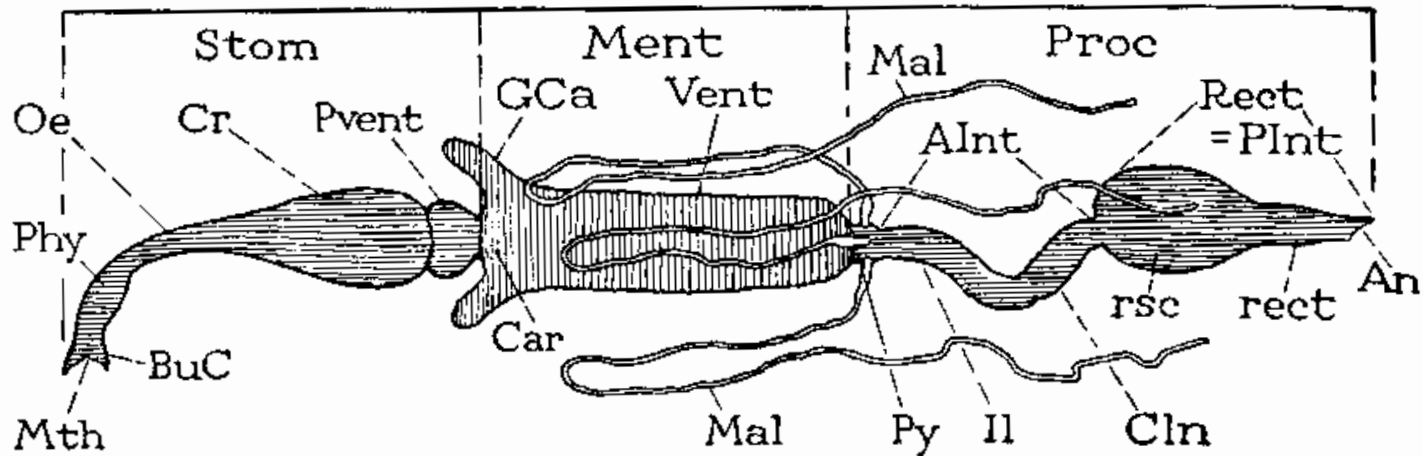




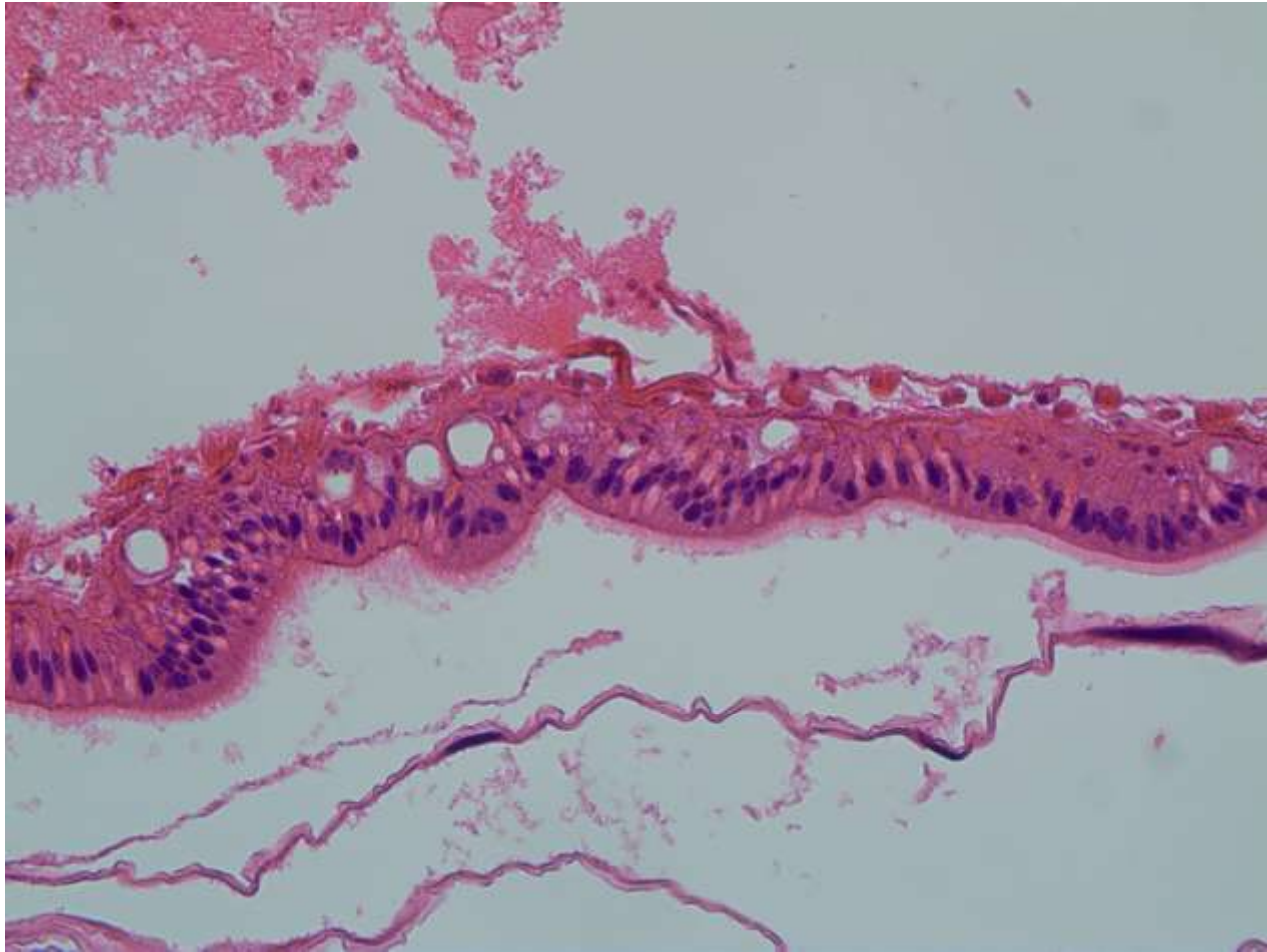
# Proventriculus- Gastric Junction



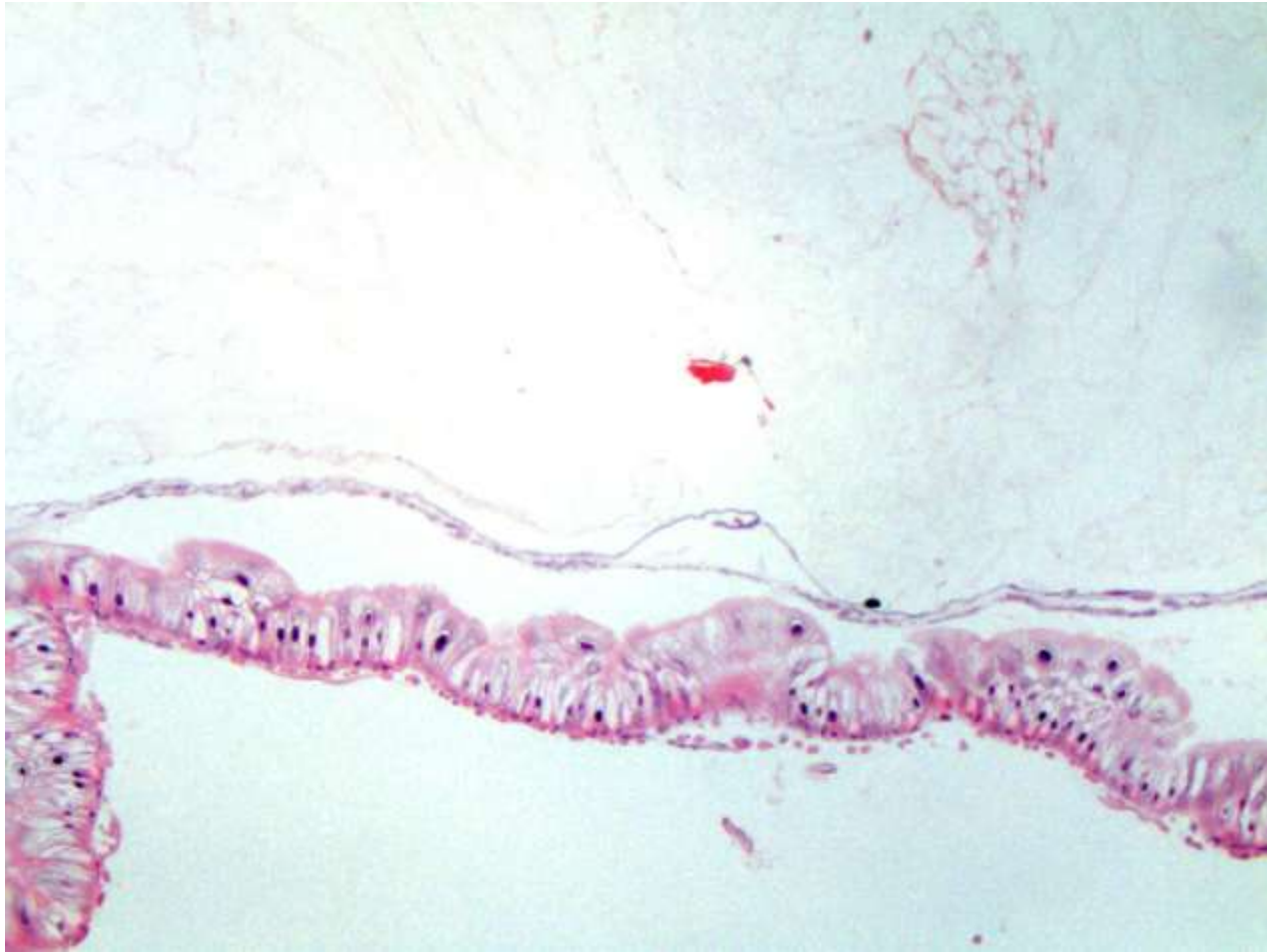
# Gastrointestinal Tract



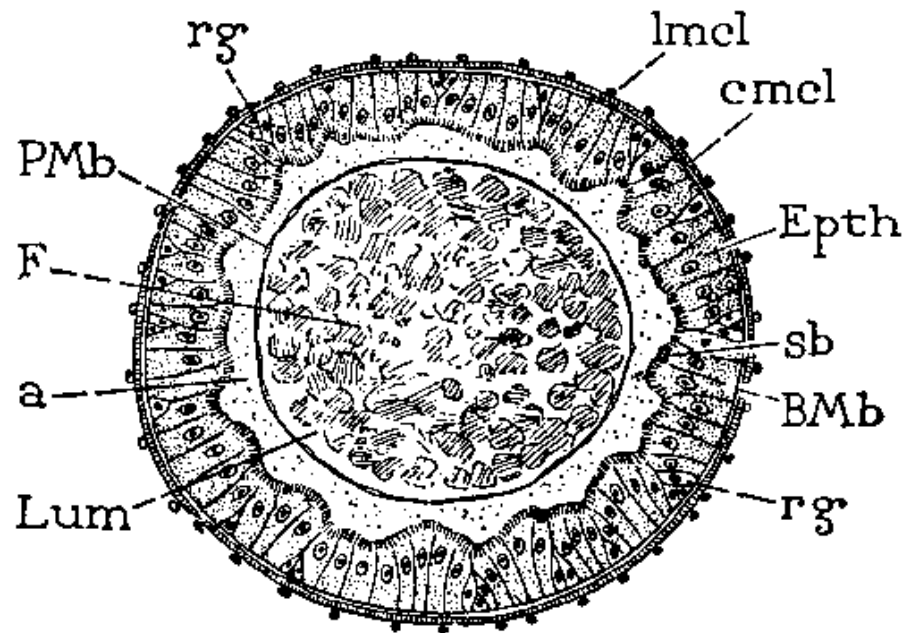
# Midgut



# Noctuid Larval Midgut

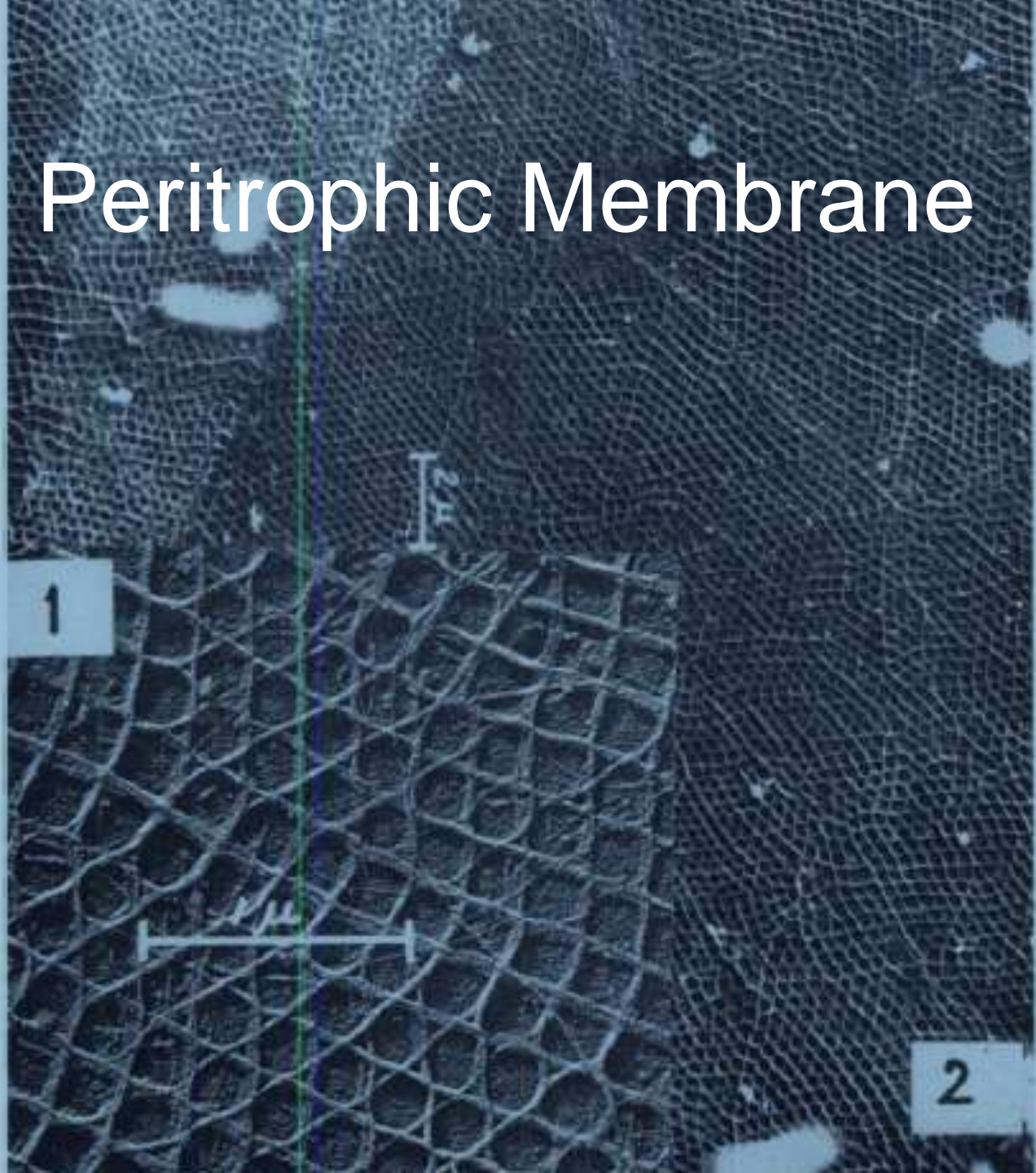


# Midgut (Ventriculus)

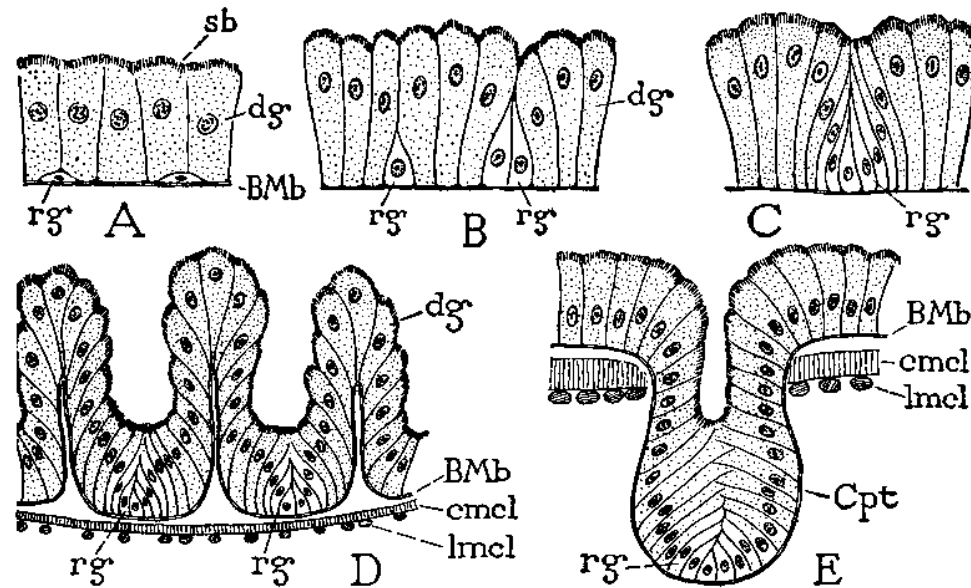




# Peritrophic Membrane



# Midgut Epiithelium

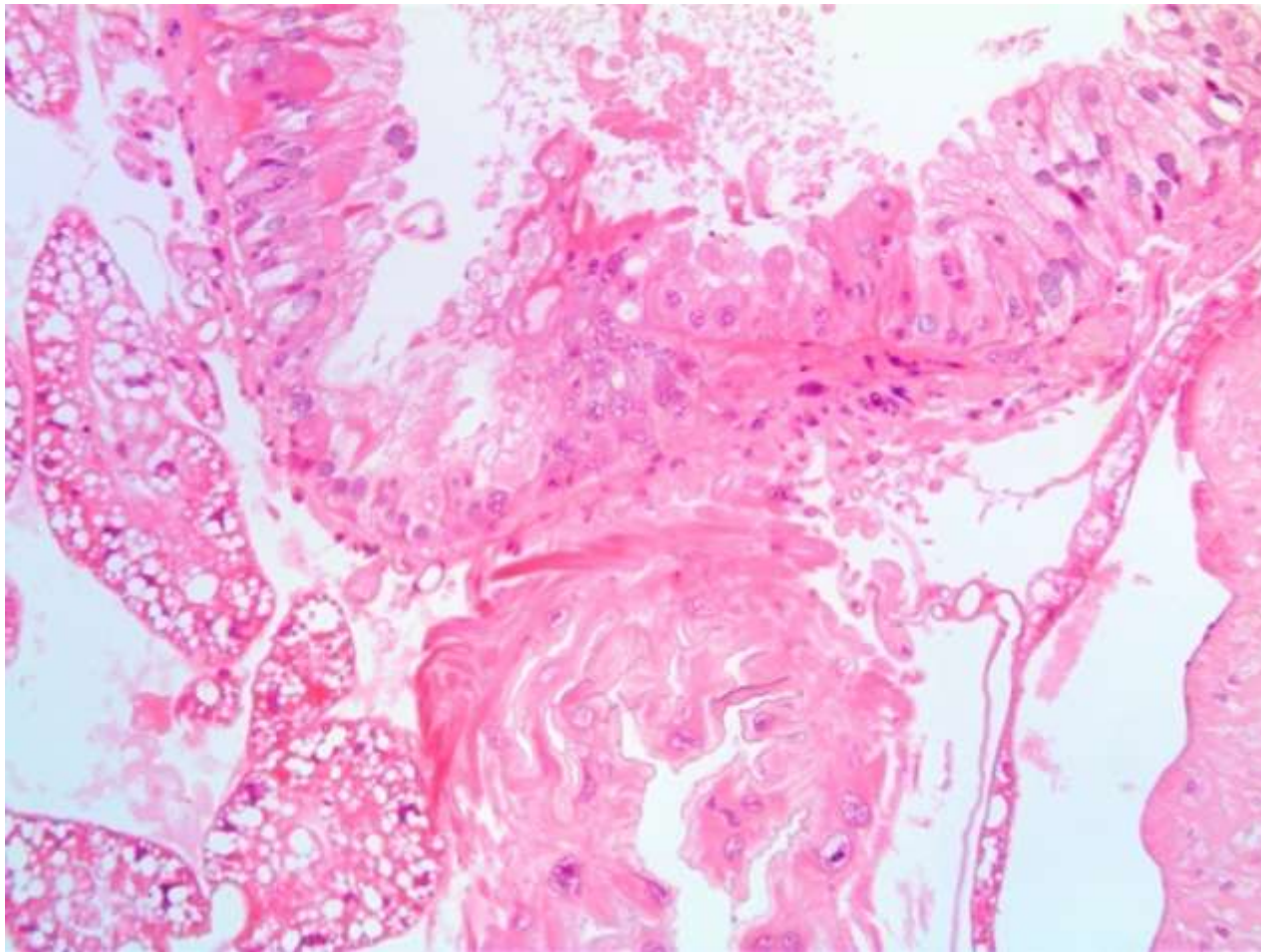




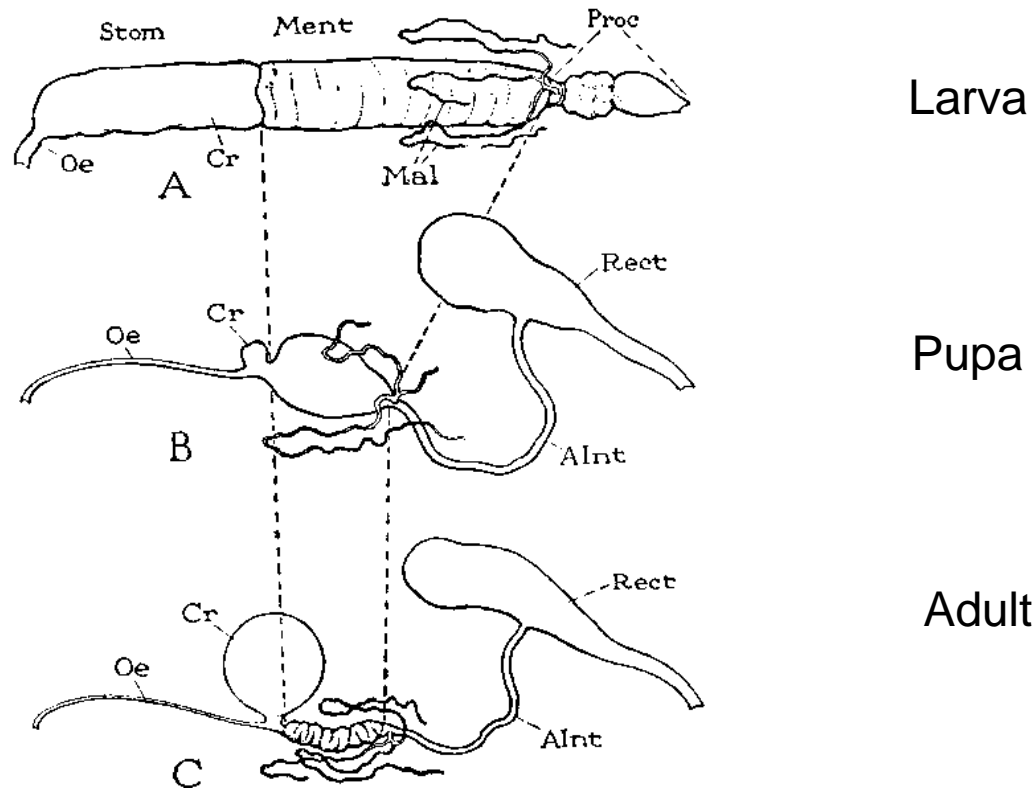
# Midgut in Larval *Grammia incorrupta*



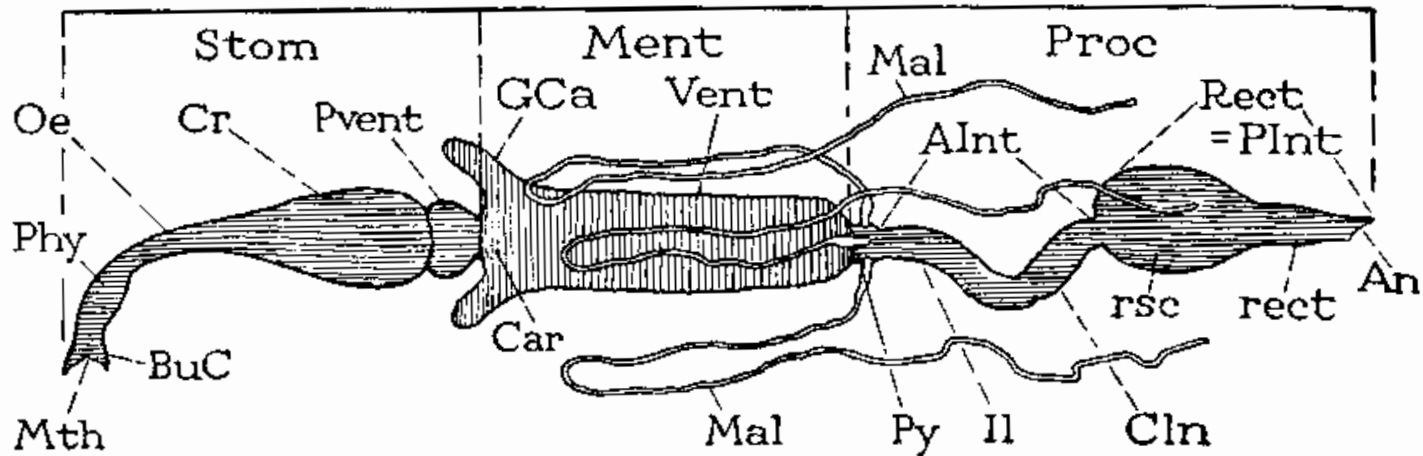
# Midgut in Adult *Arachnis picta*



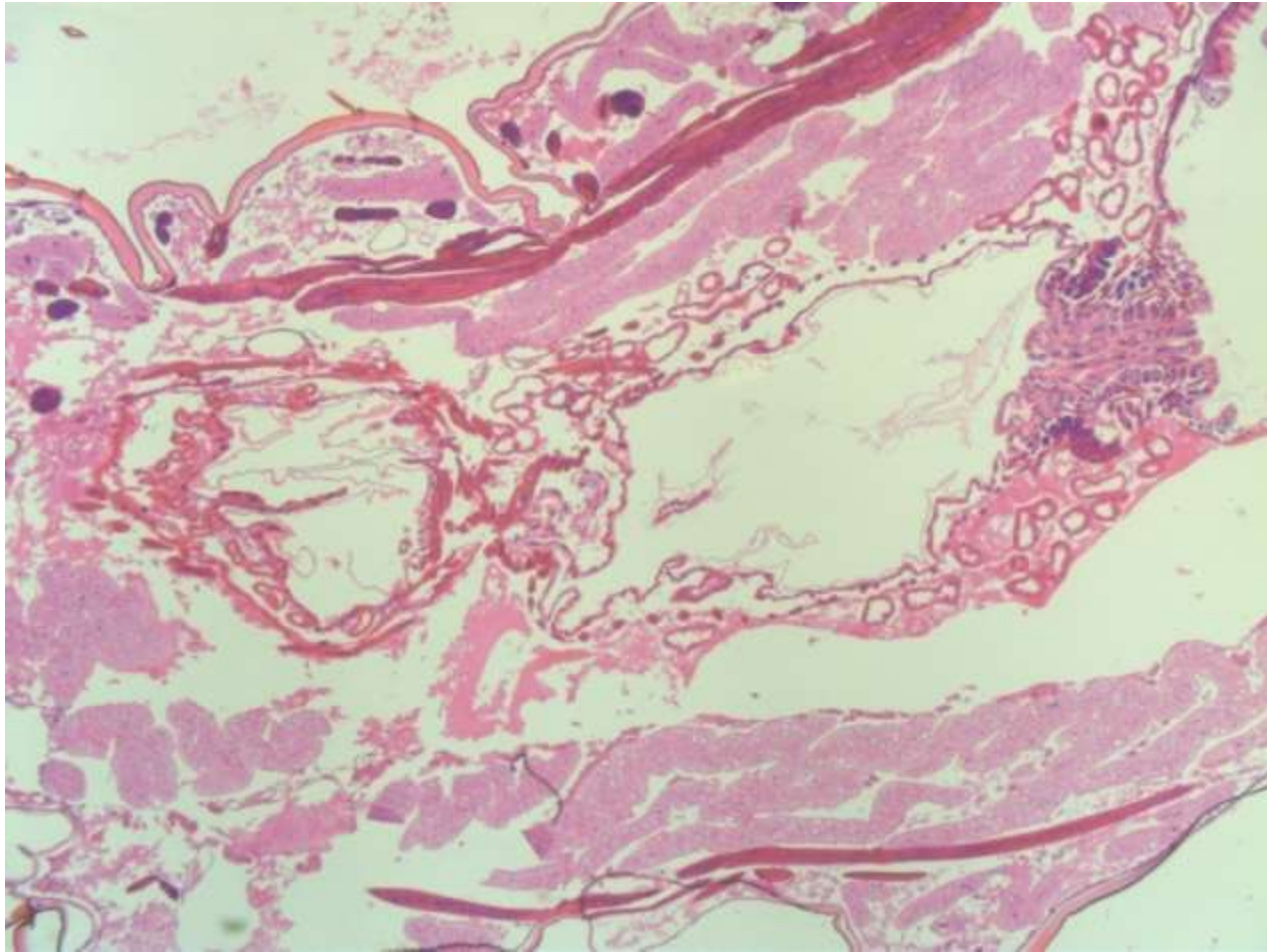
# Changes in GI Tract with Development



# Gastrointestinal Tract

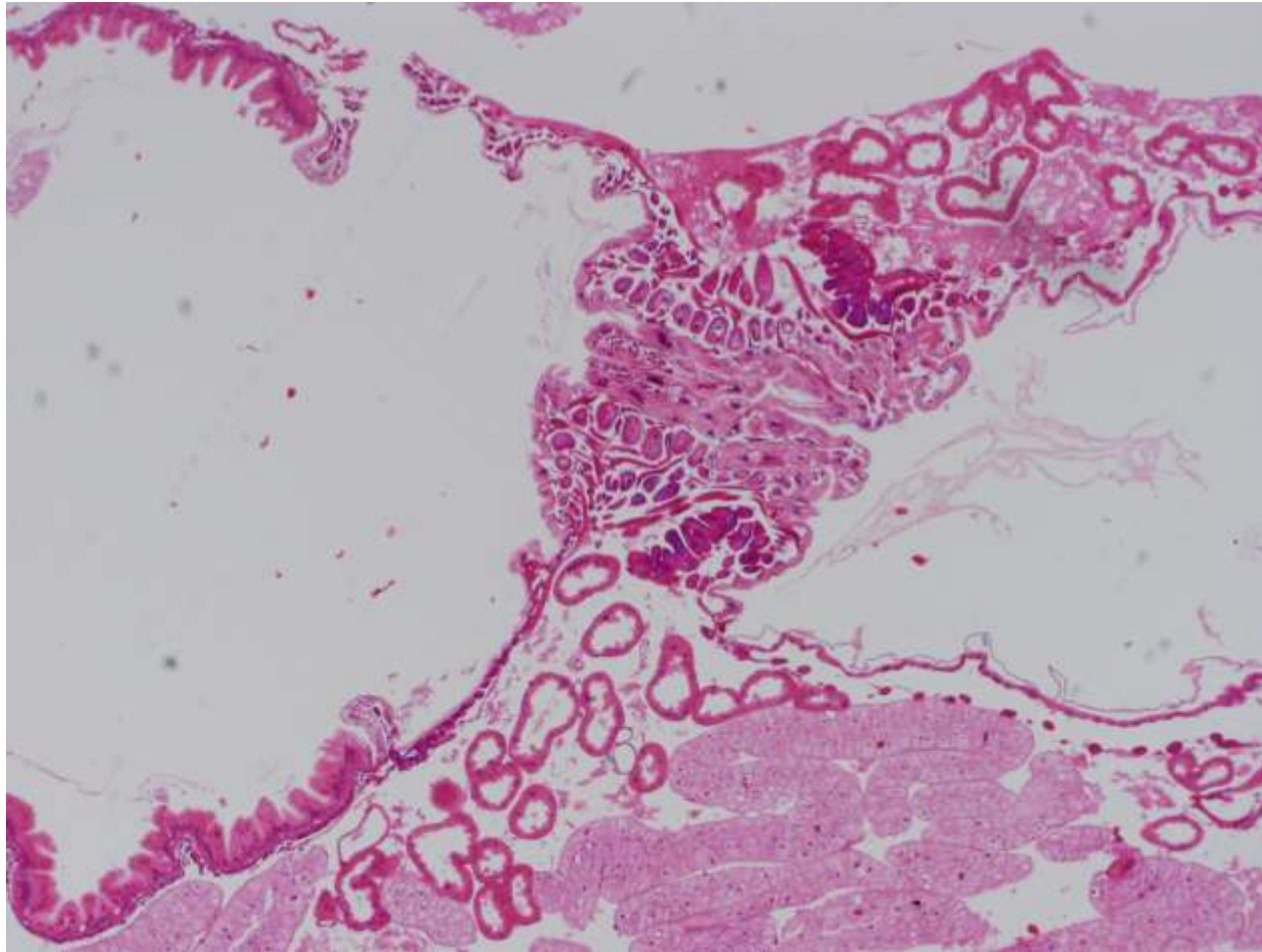


# Hindgut

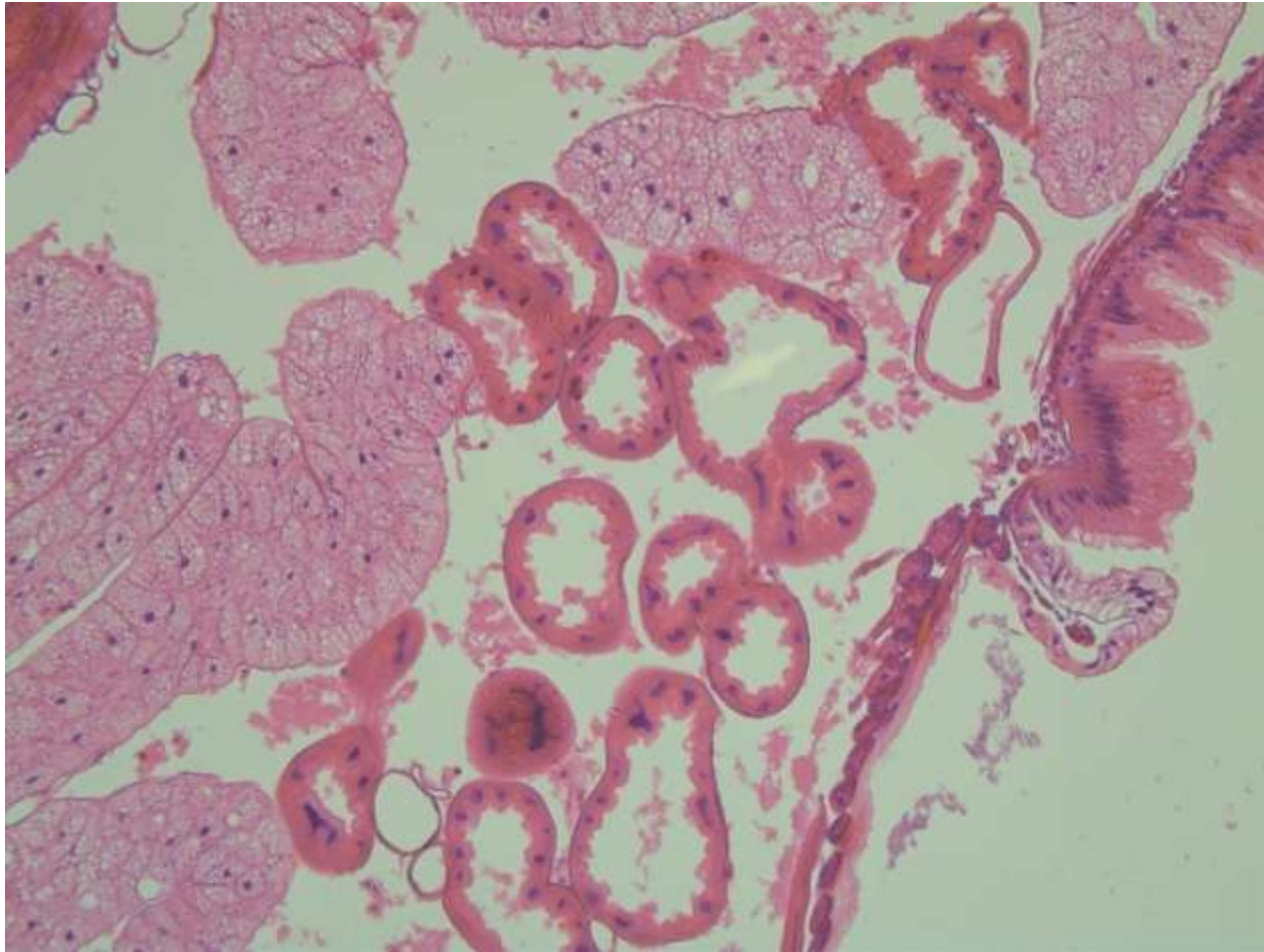




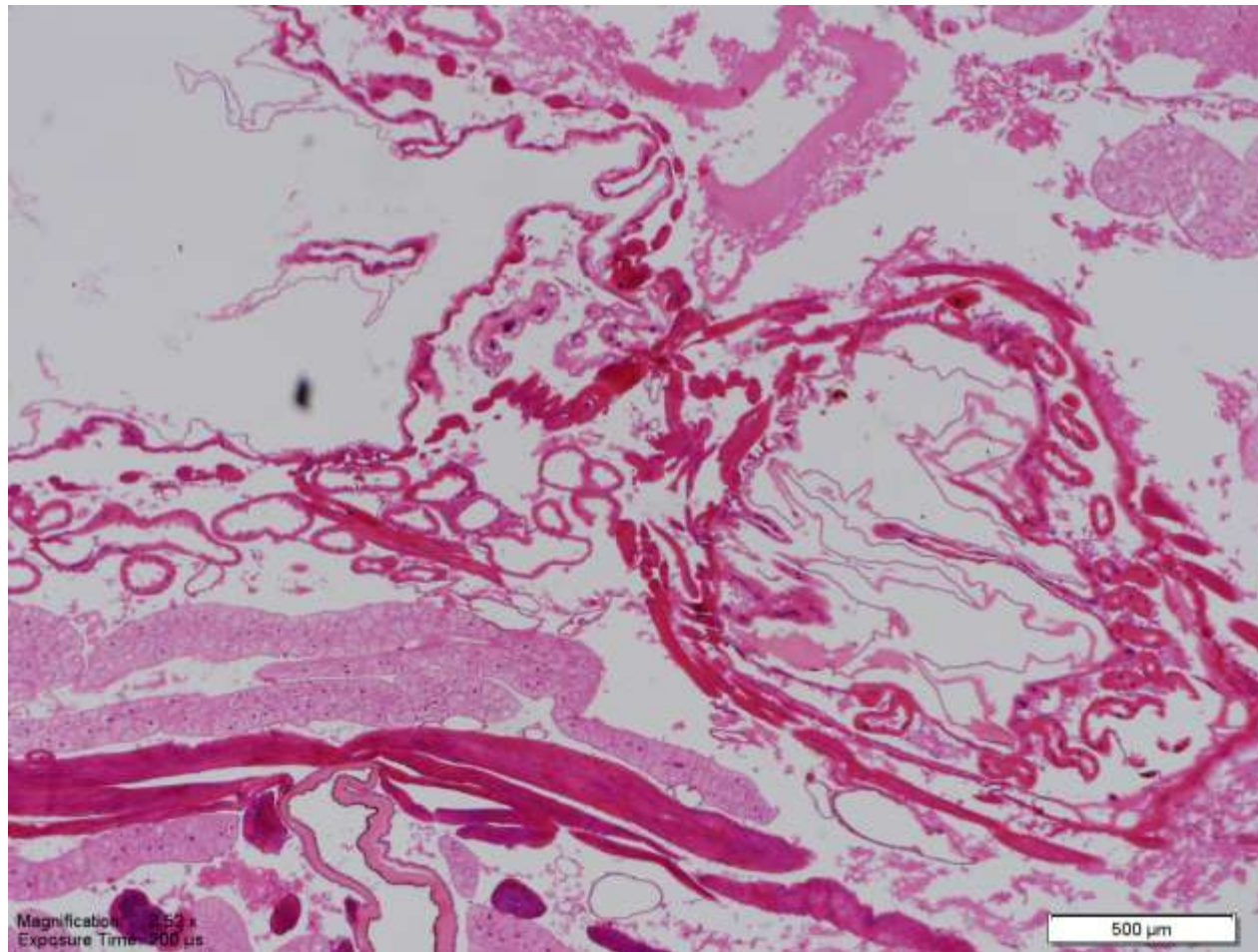
# A. Picta Pylorus



# Midgut- Hindgut

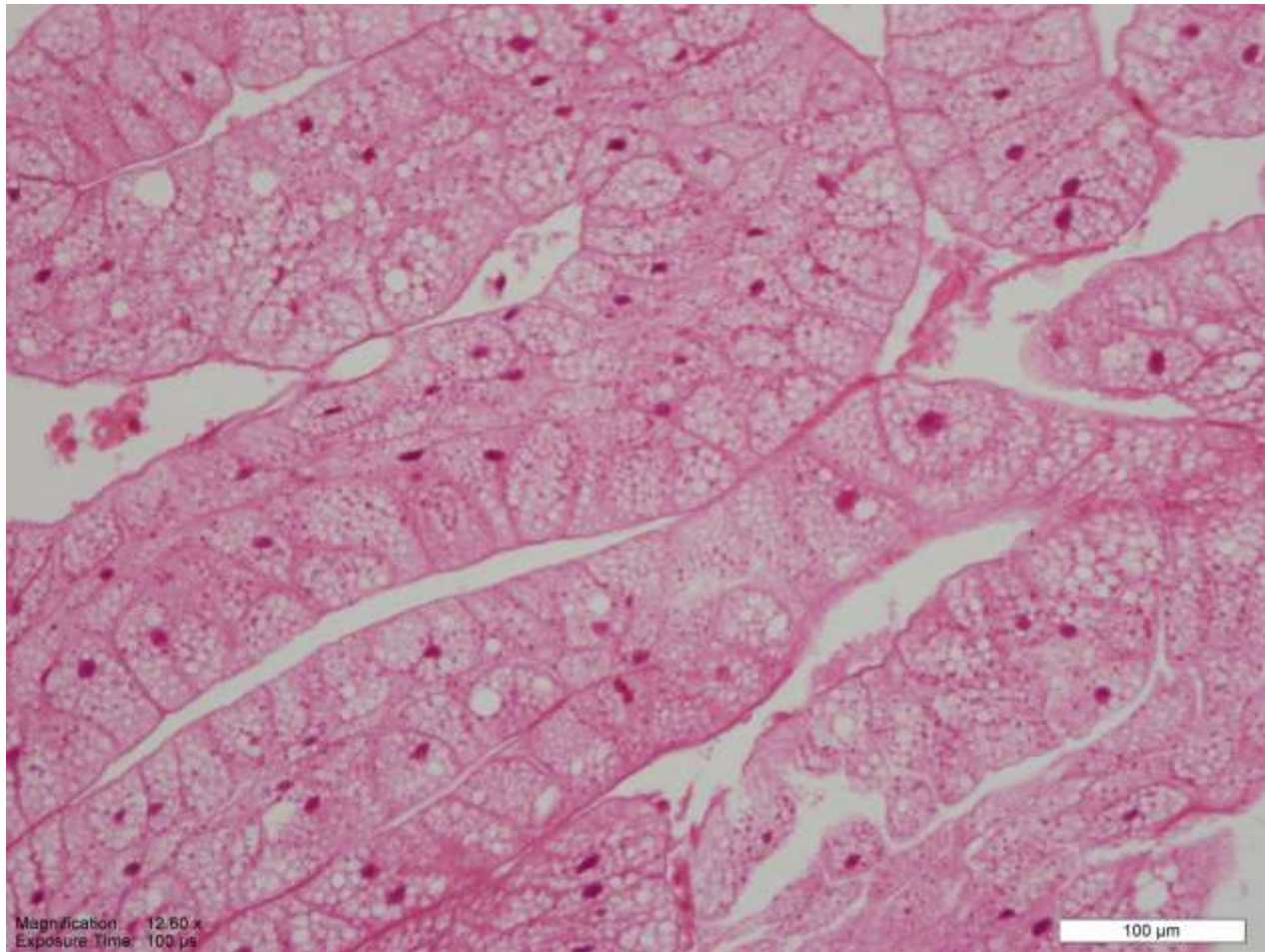


# Colon and Rectum

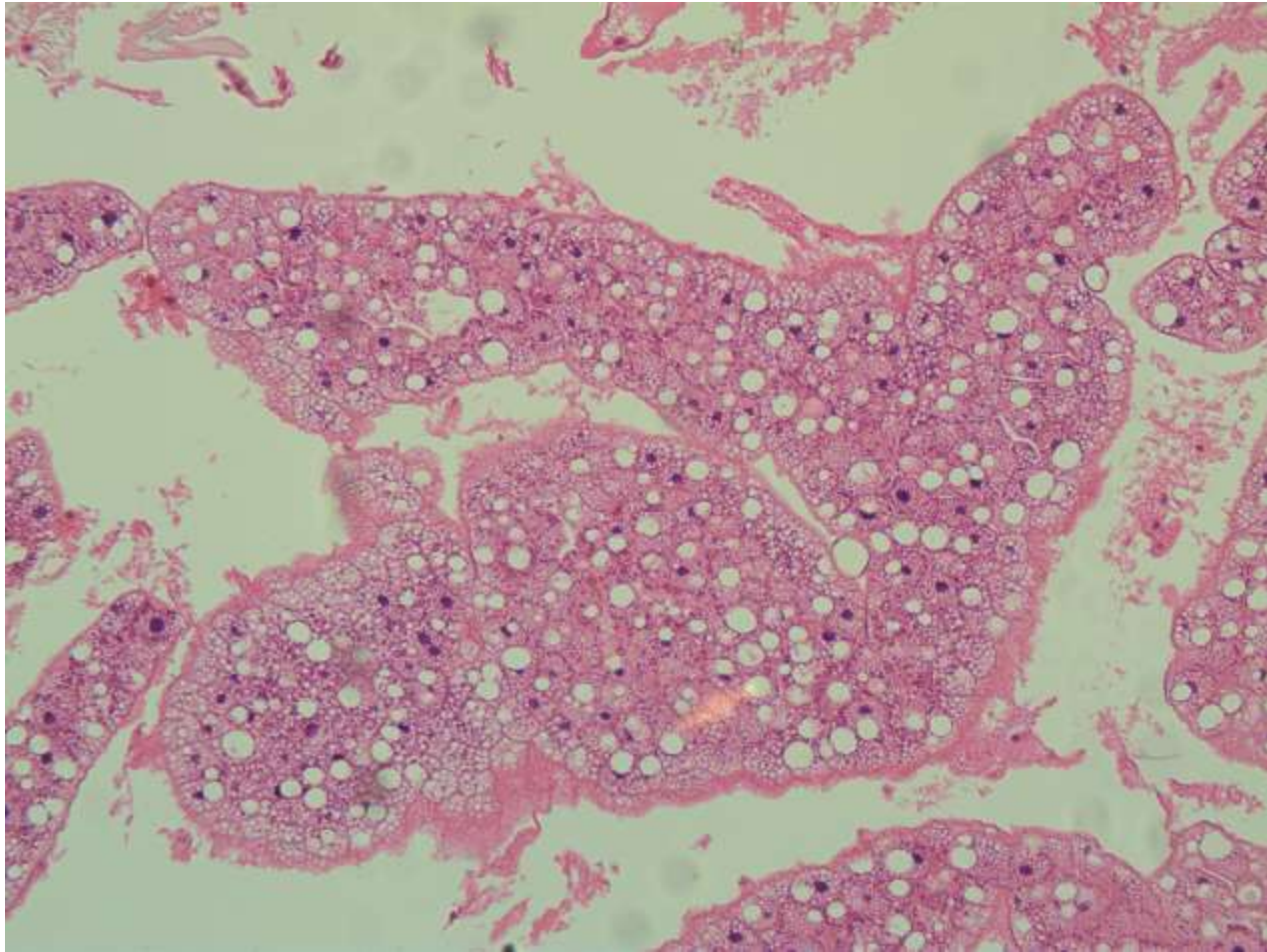




# Fat Body in Larval *Grammia incorrupta*

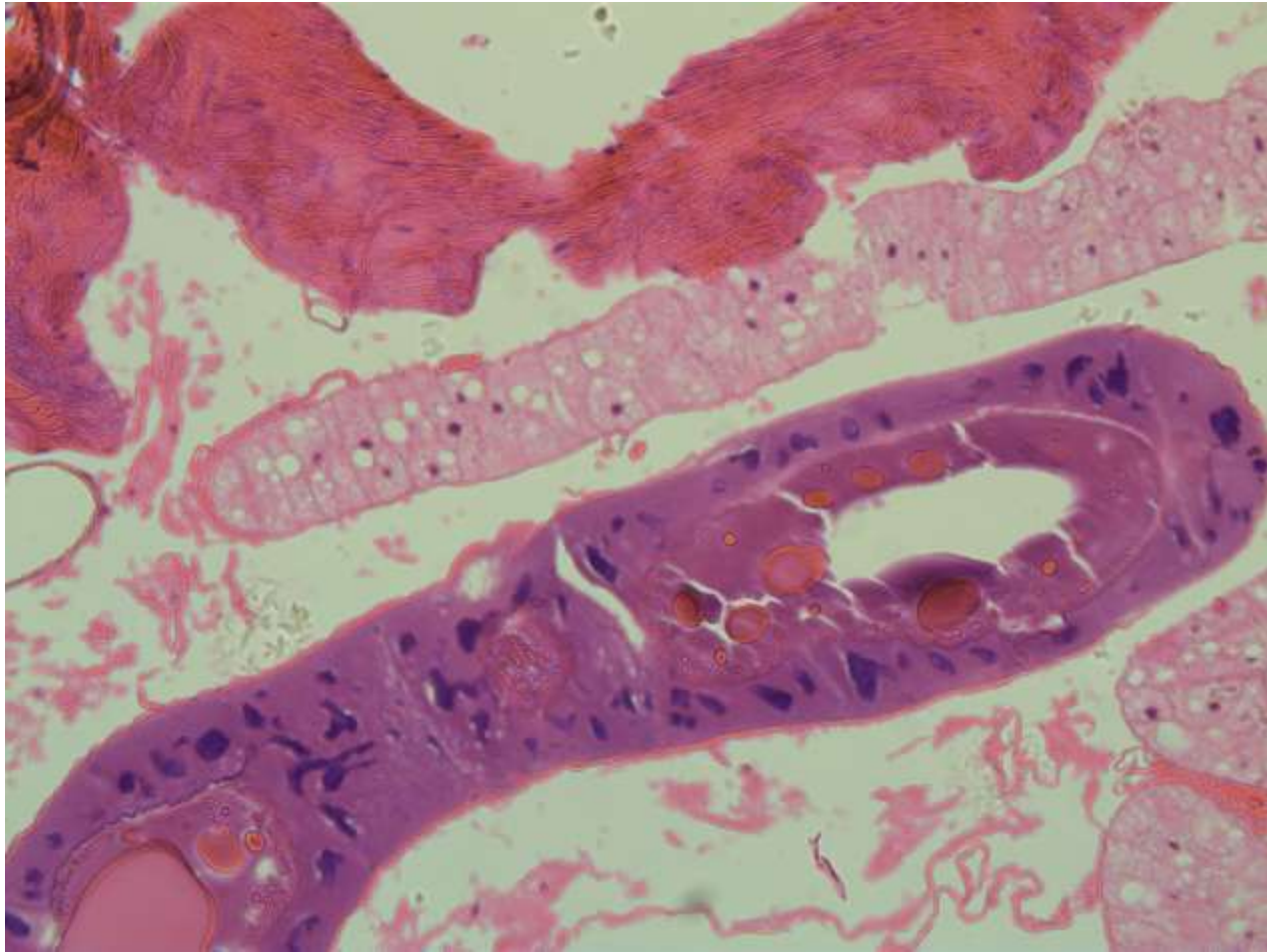


# Adult Fat Body

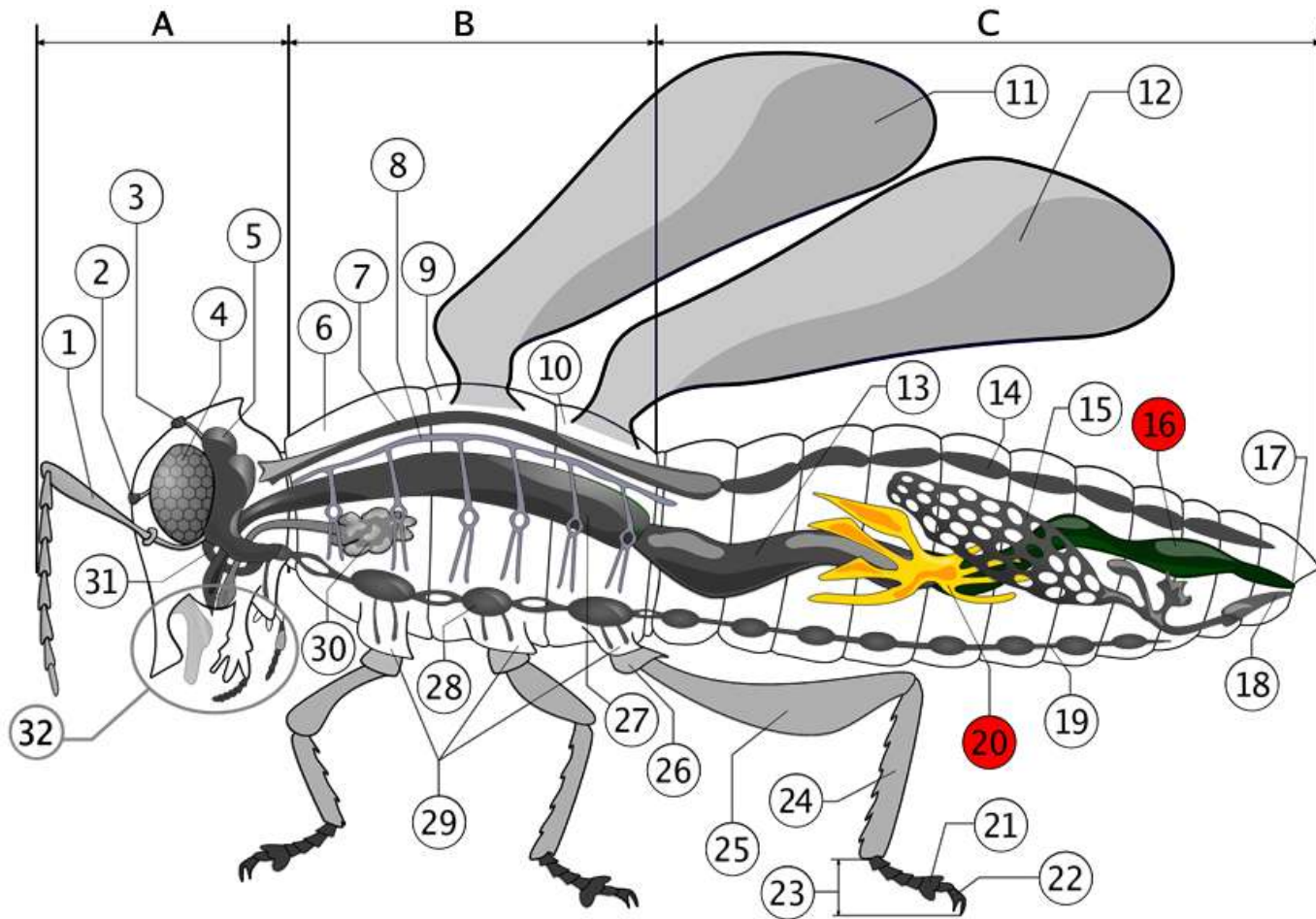




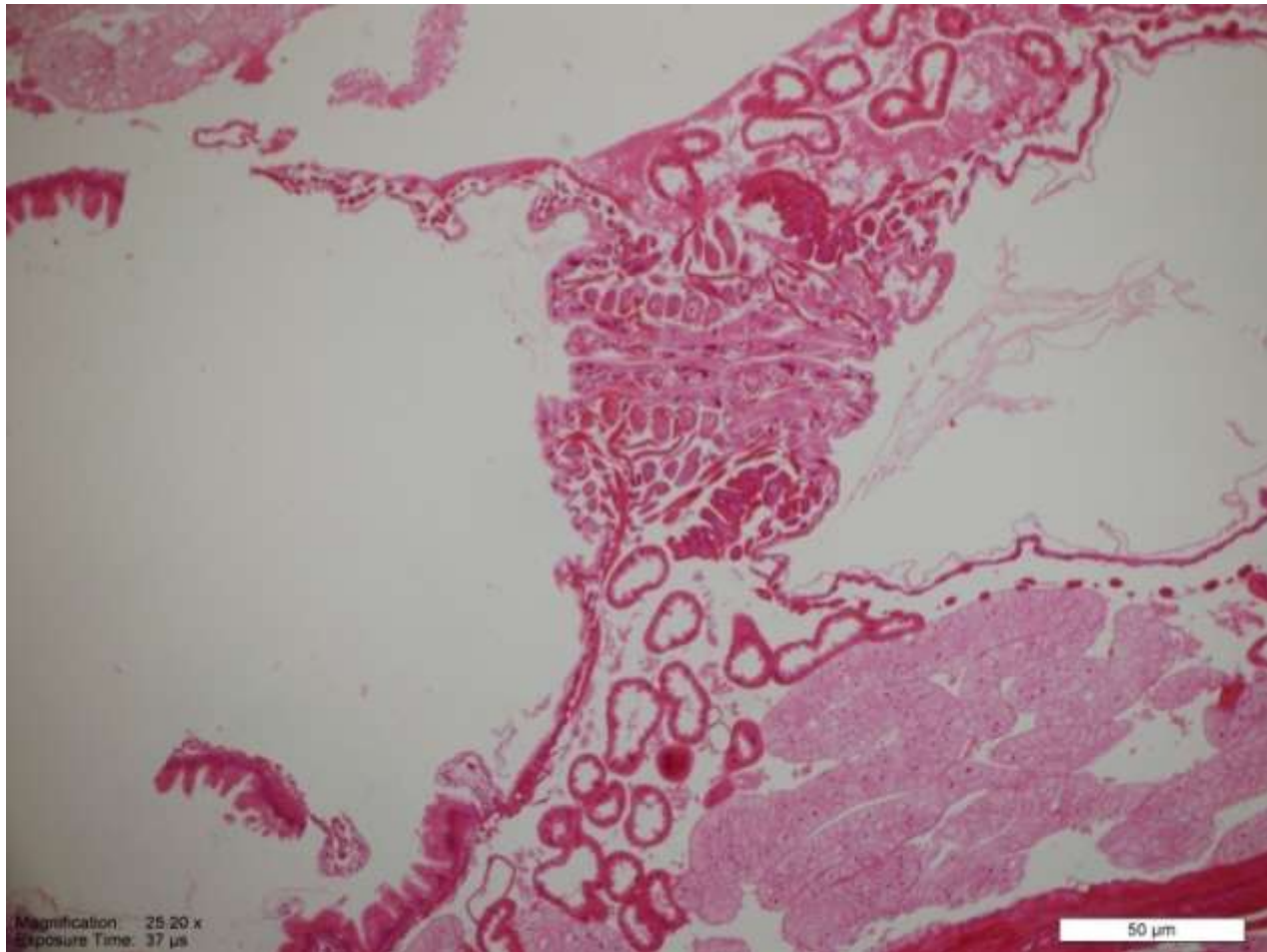
# Silk Gland



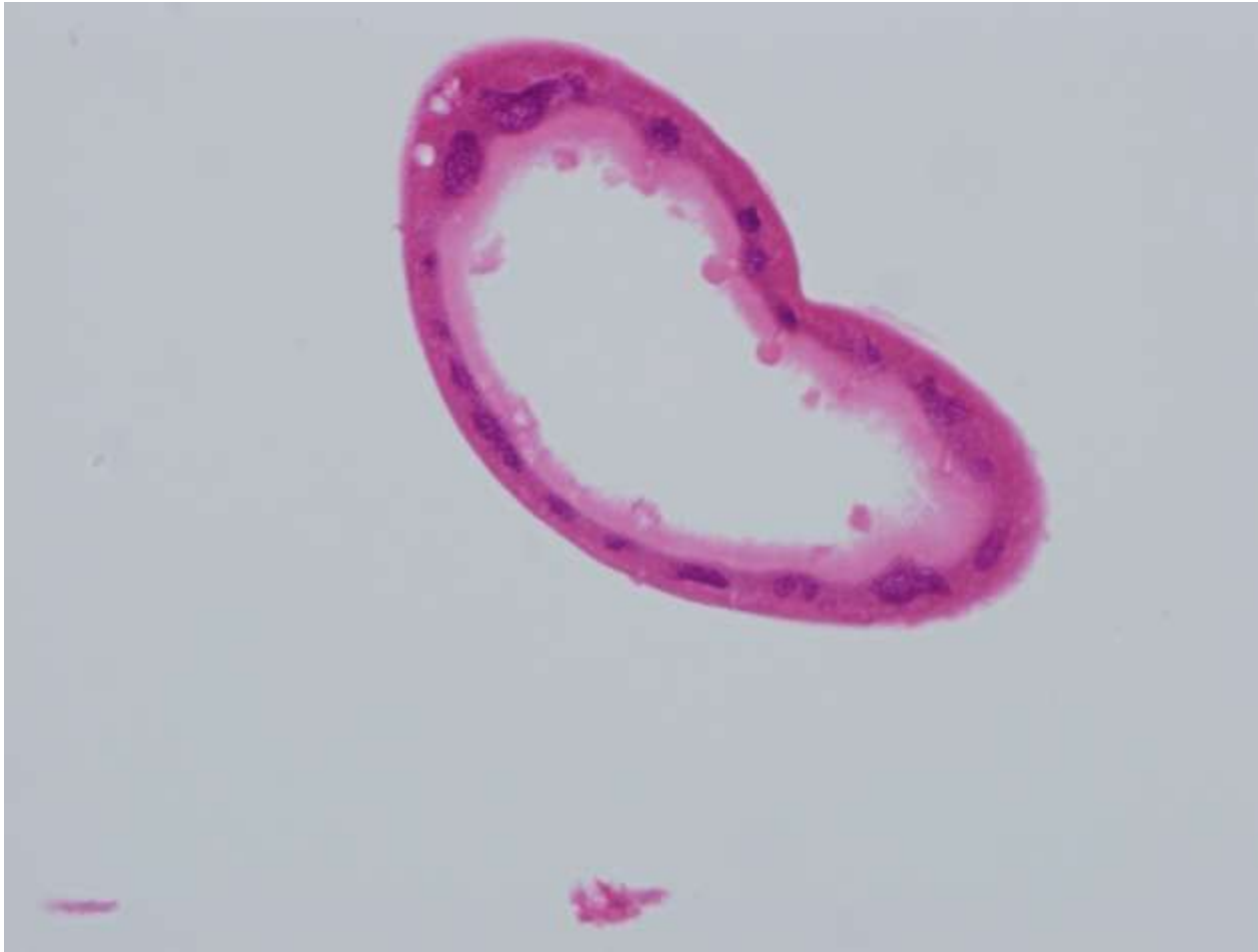
# Excretory System



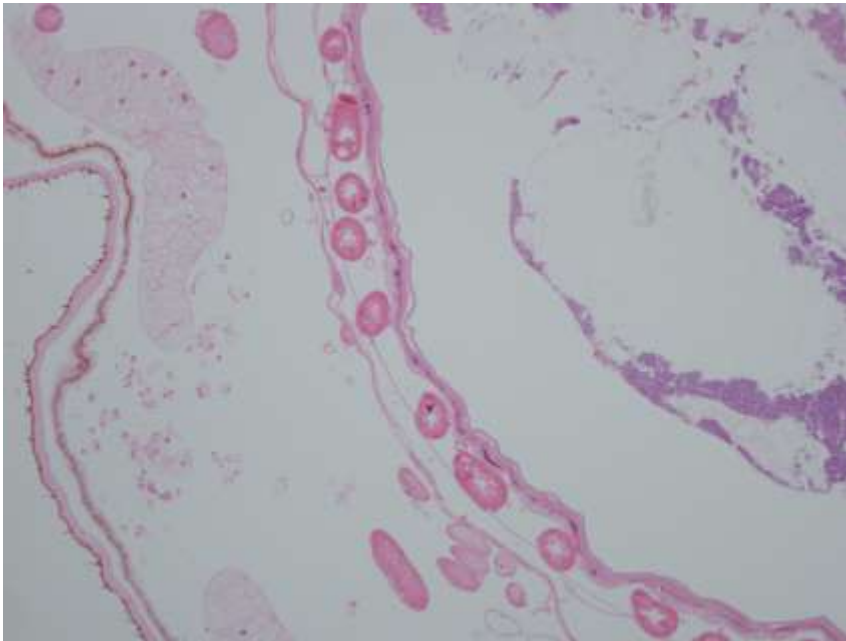
# Malpighian Tubules Arising from Midgut-Hindgut Transition



# Malpighian tubule



# Rectum

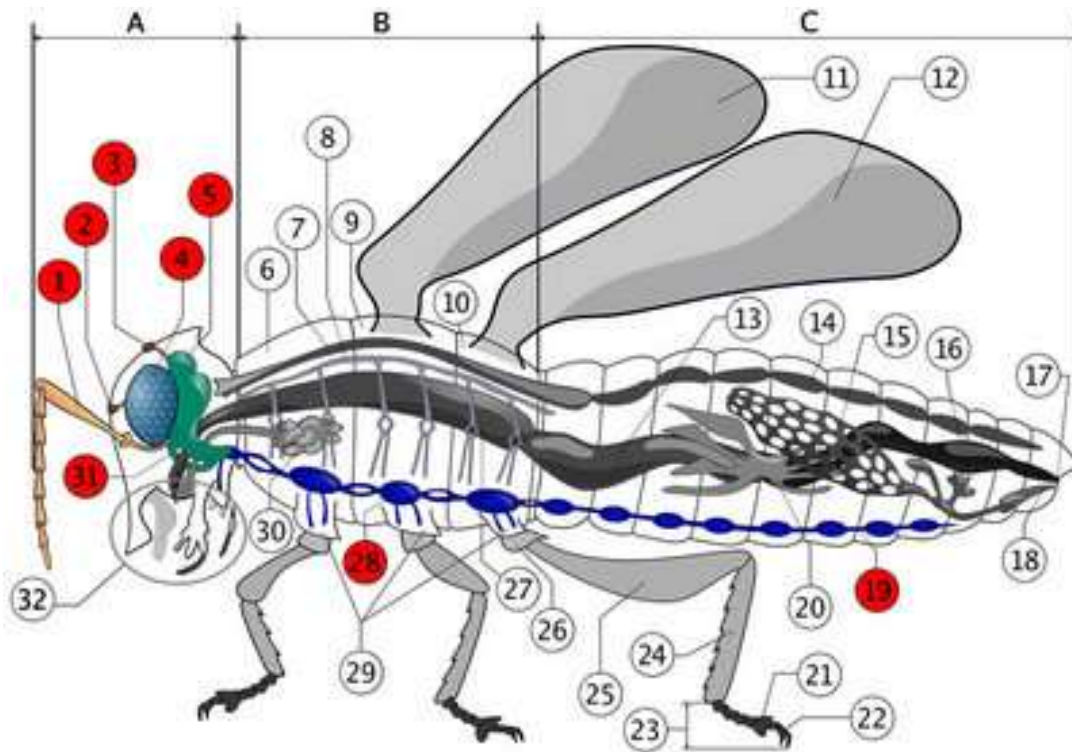




# Malpighian Tubules Adherent to Hind Gut



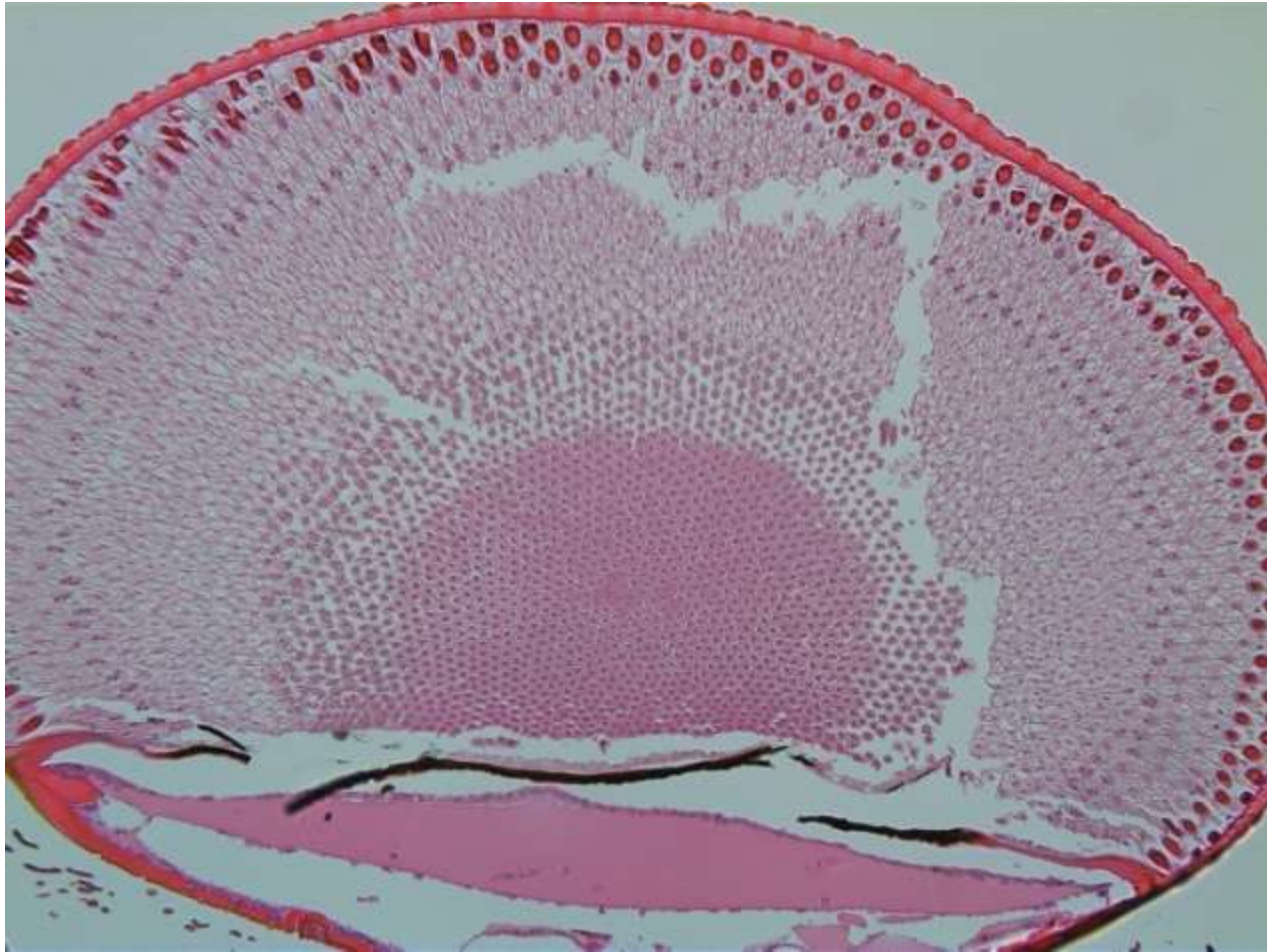
# Nervous System



# Noctuid Larval Stemmata



# Compound Eye



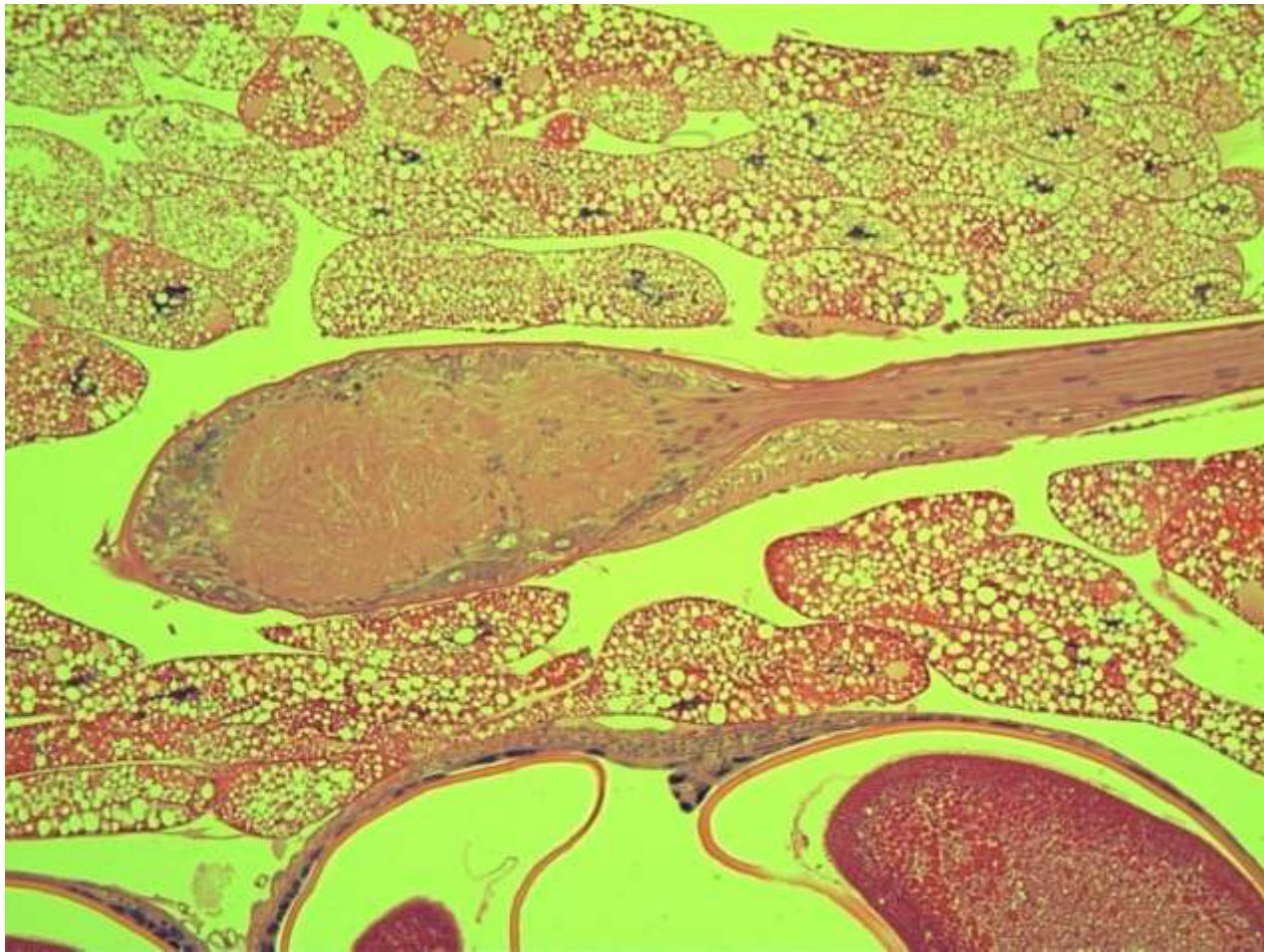


# Adult Eye and Brain

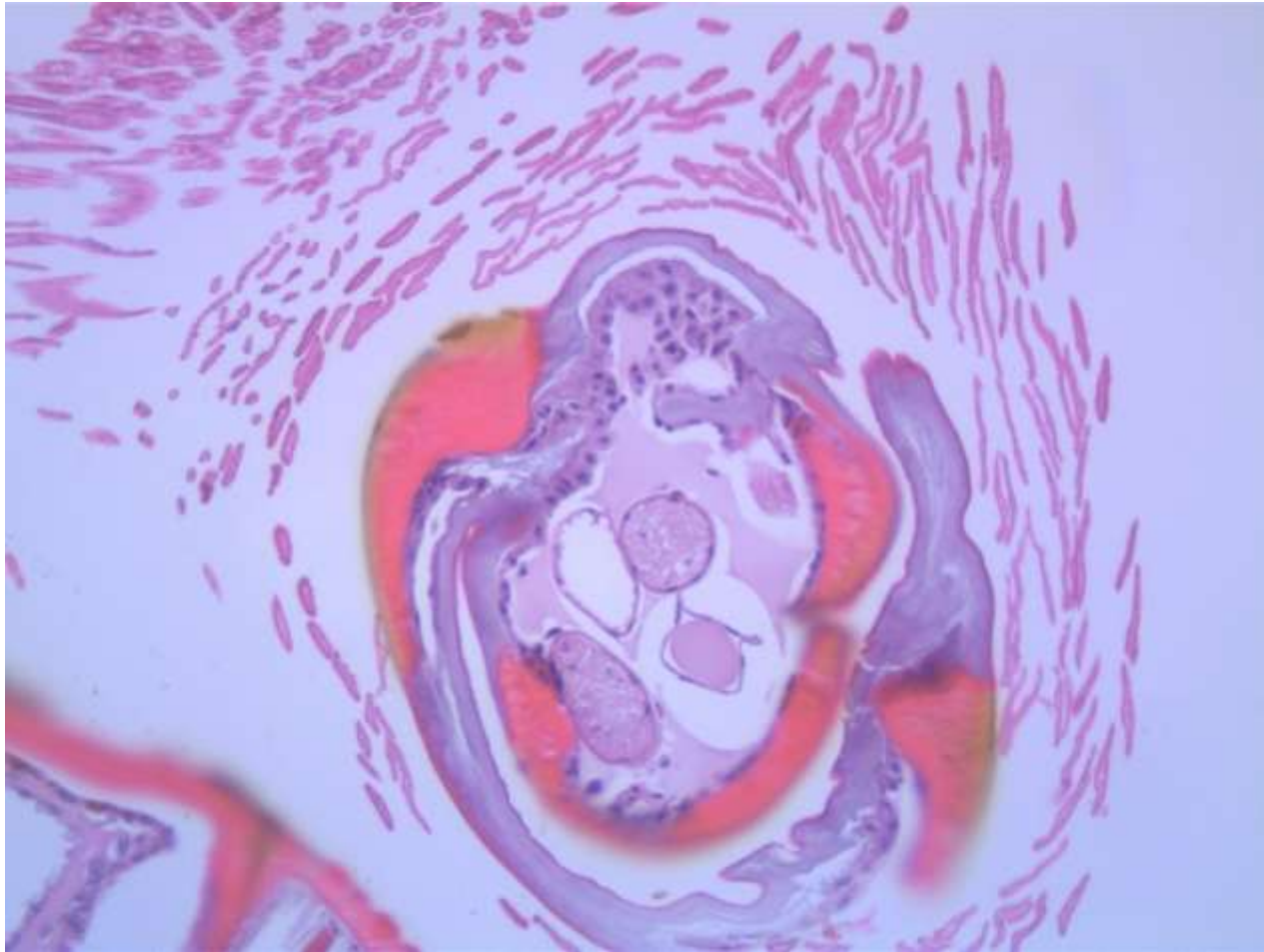




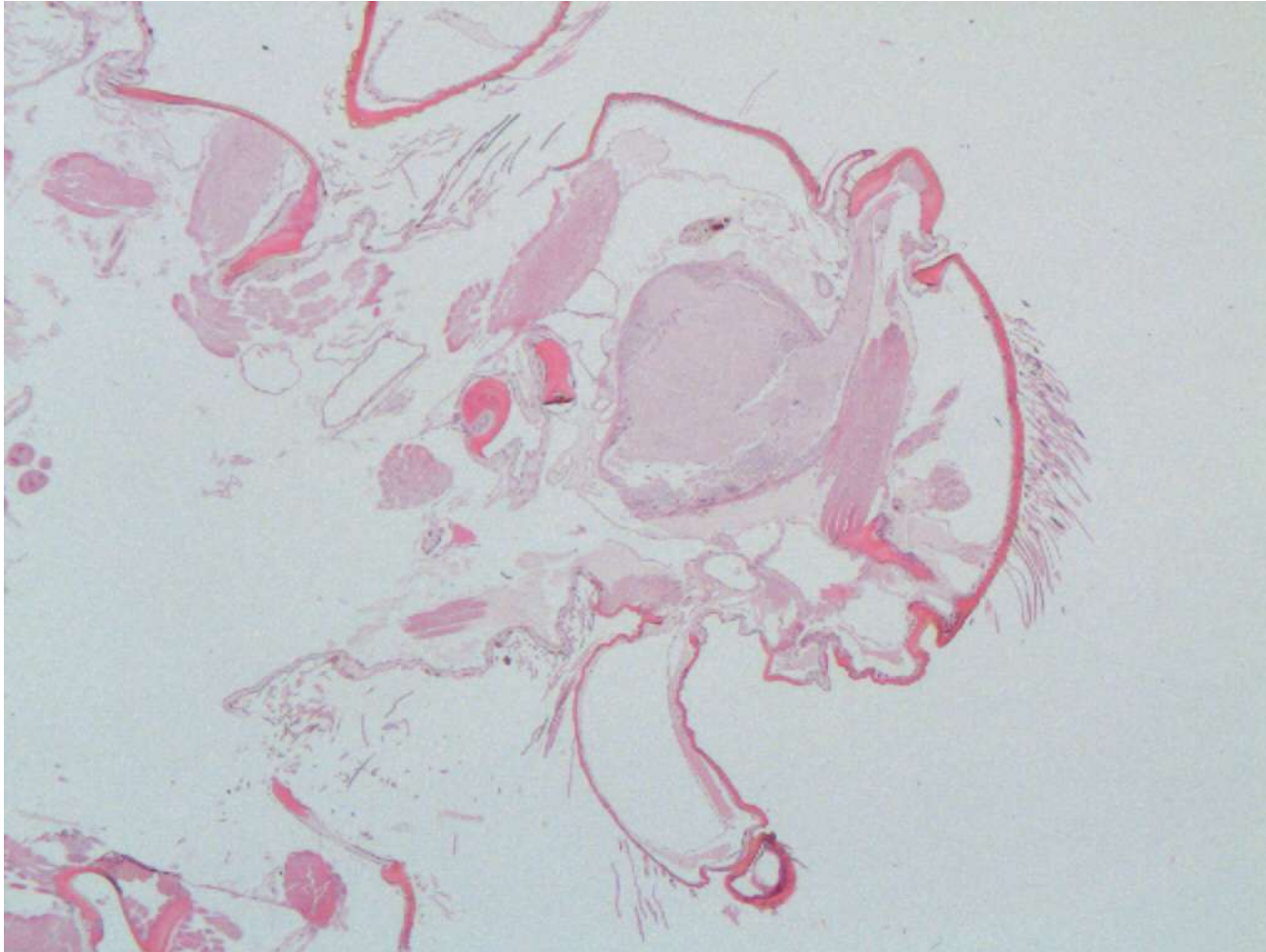
# Ventral Nerve Cord



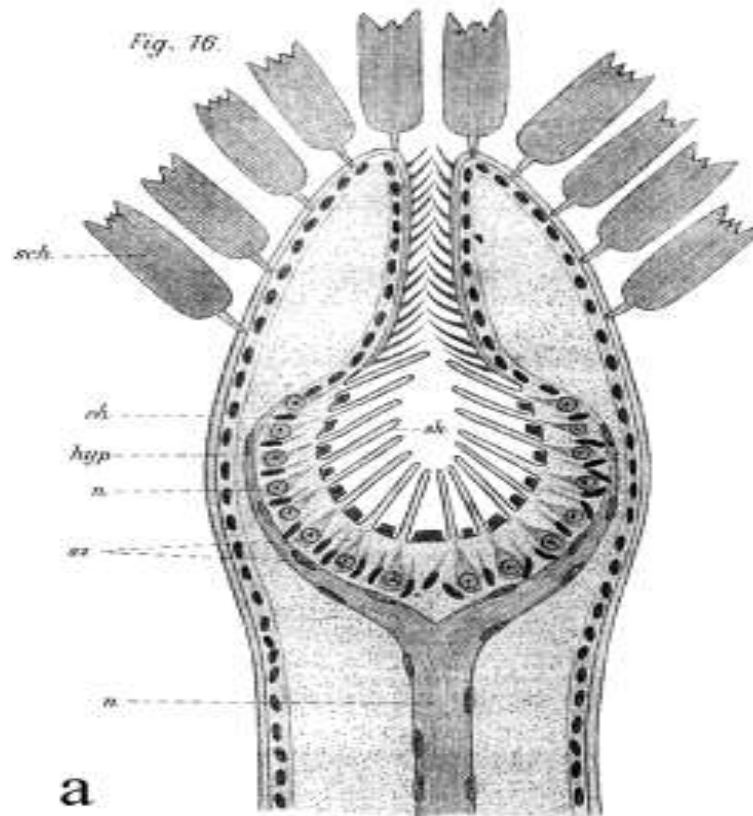
# Antennae



# Labial Palp



# Organ of vom Rath from Labial Palp of *Pieris rapae*



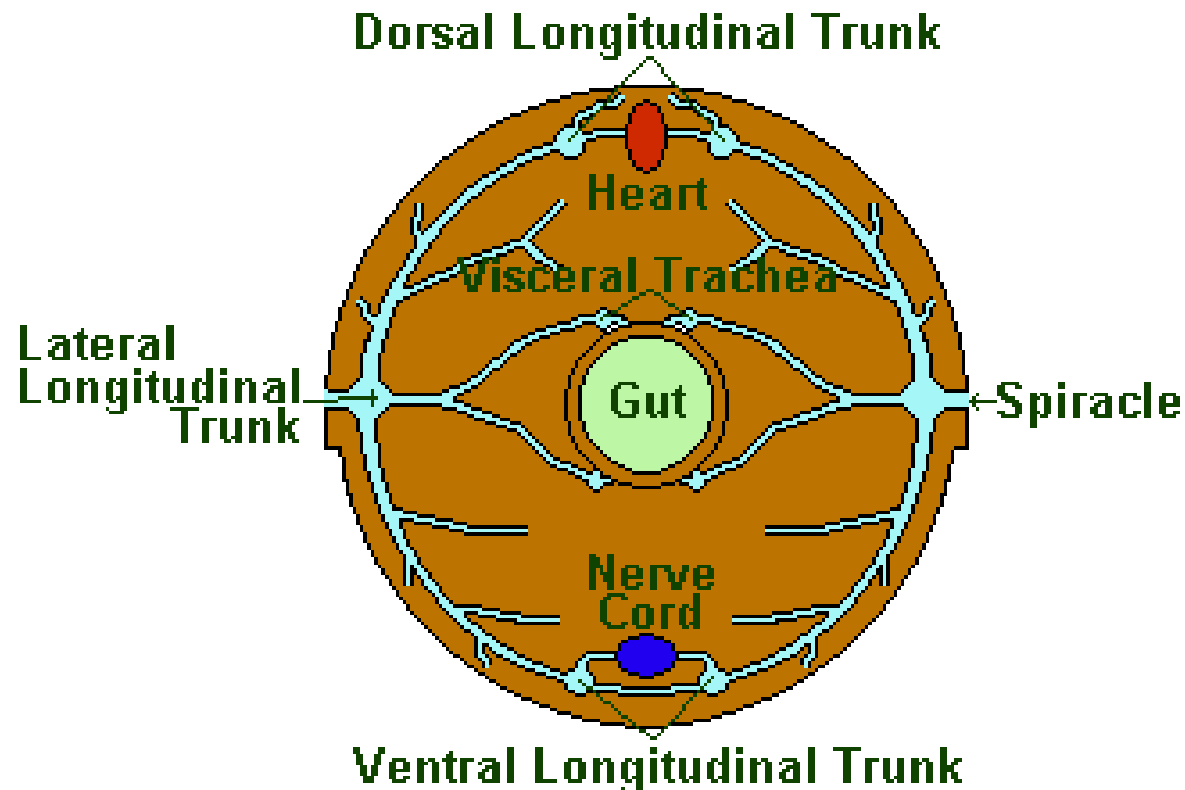
# Respiratory System



# Larval Spiracles



# Diagrammatic Representation in TS of the Insect Tracheal System



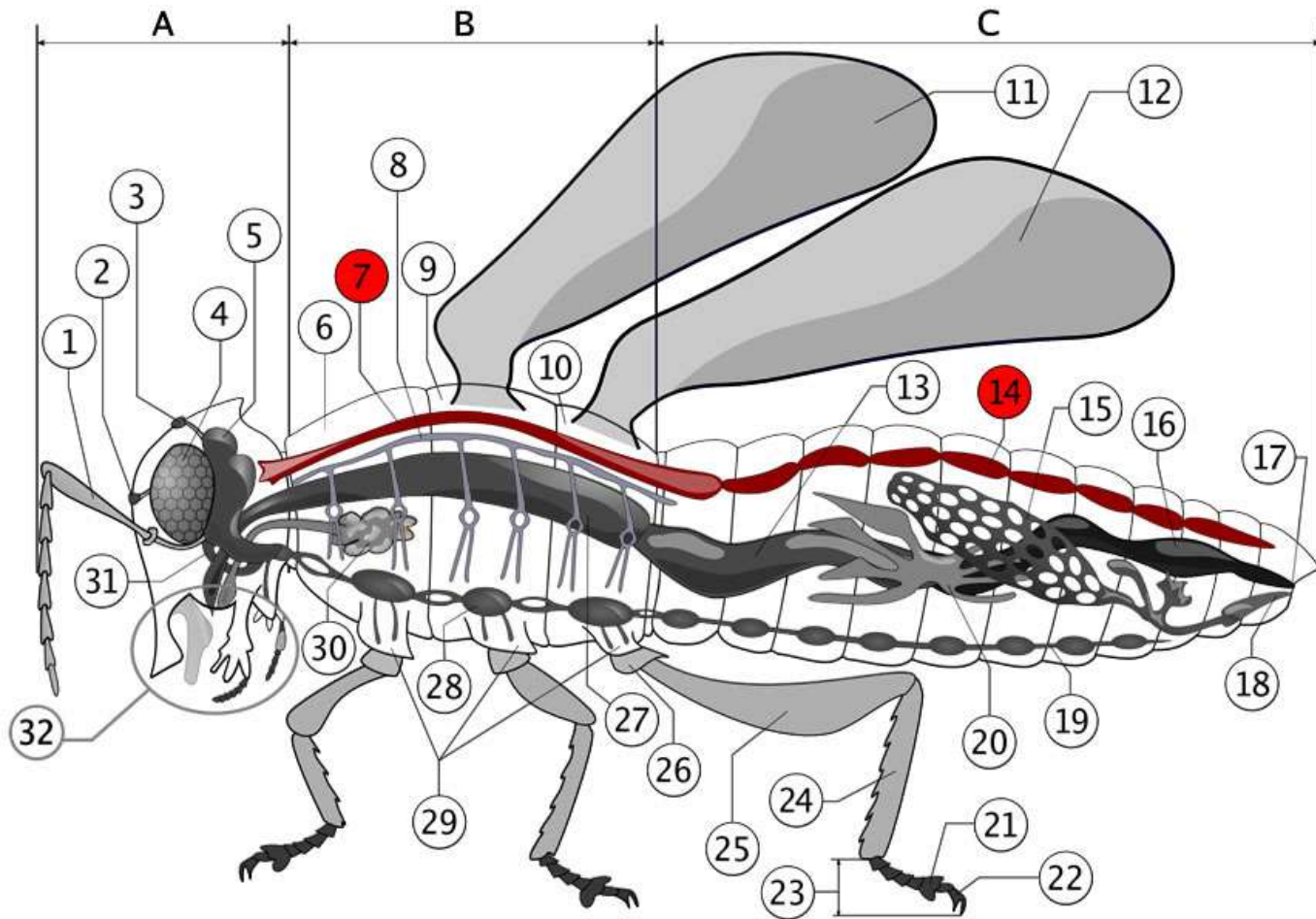
# Noctuid Larval Tracheal System



# Tracheal System



# Circulatory System

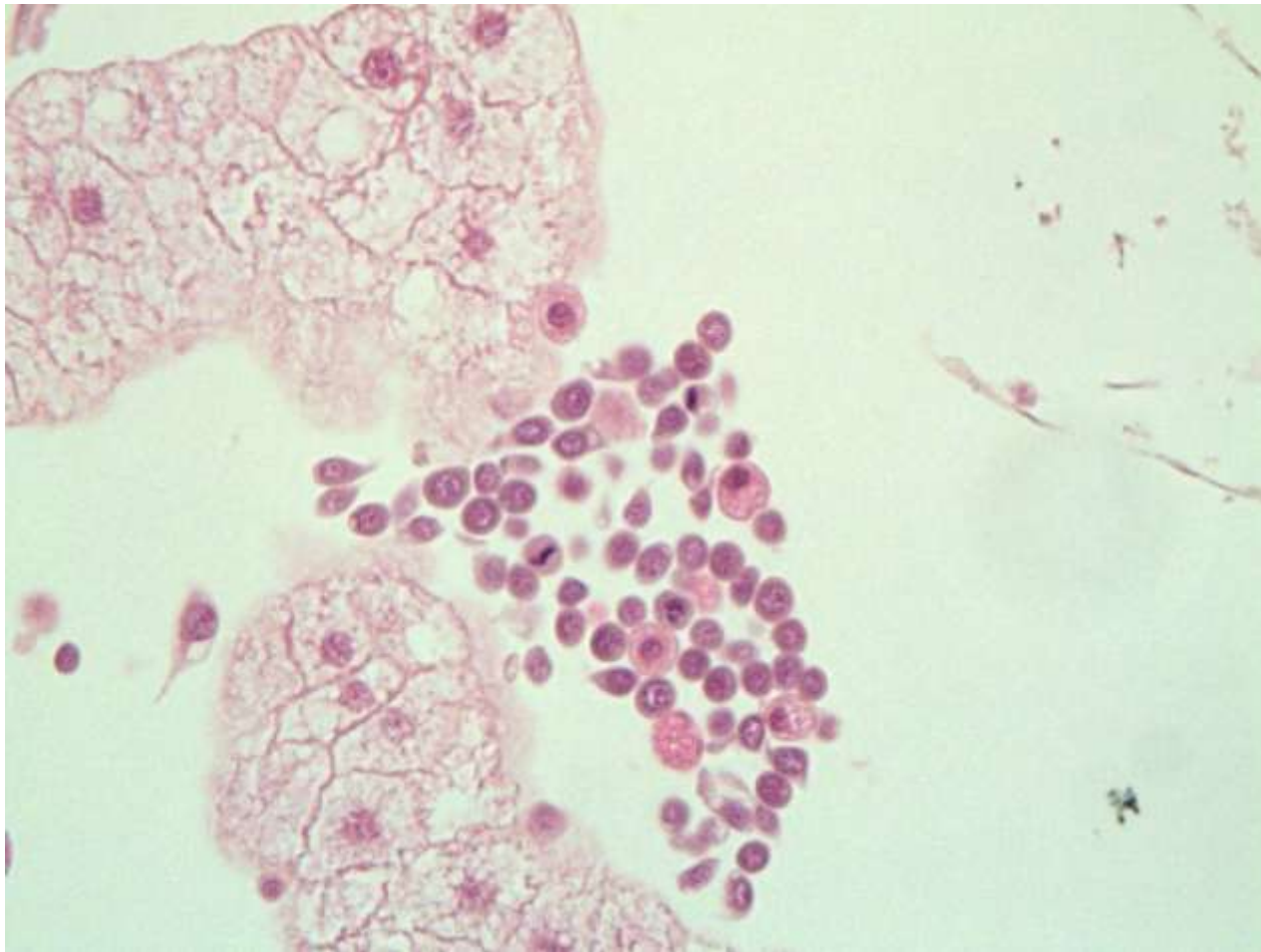




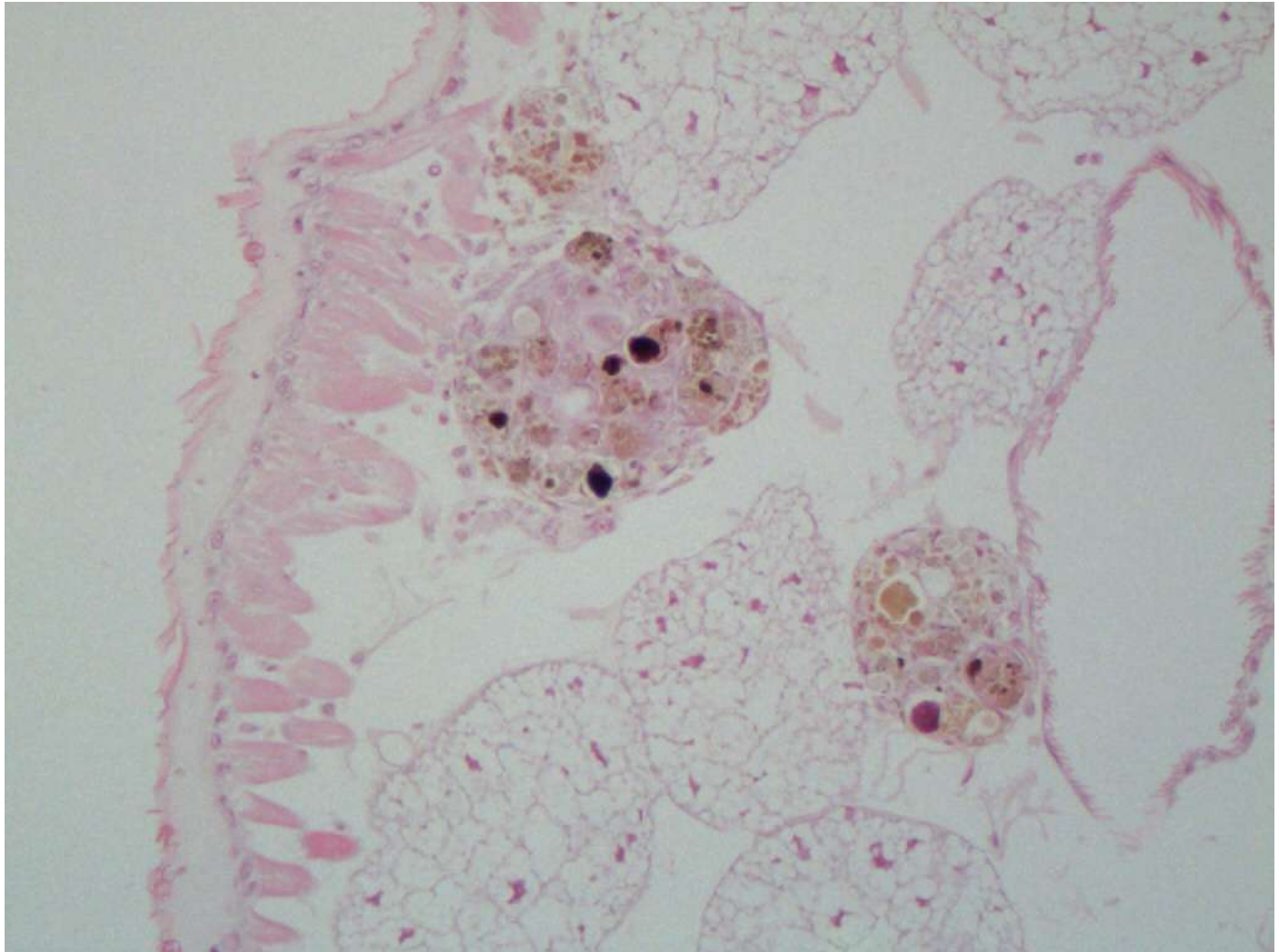
# Heart



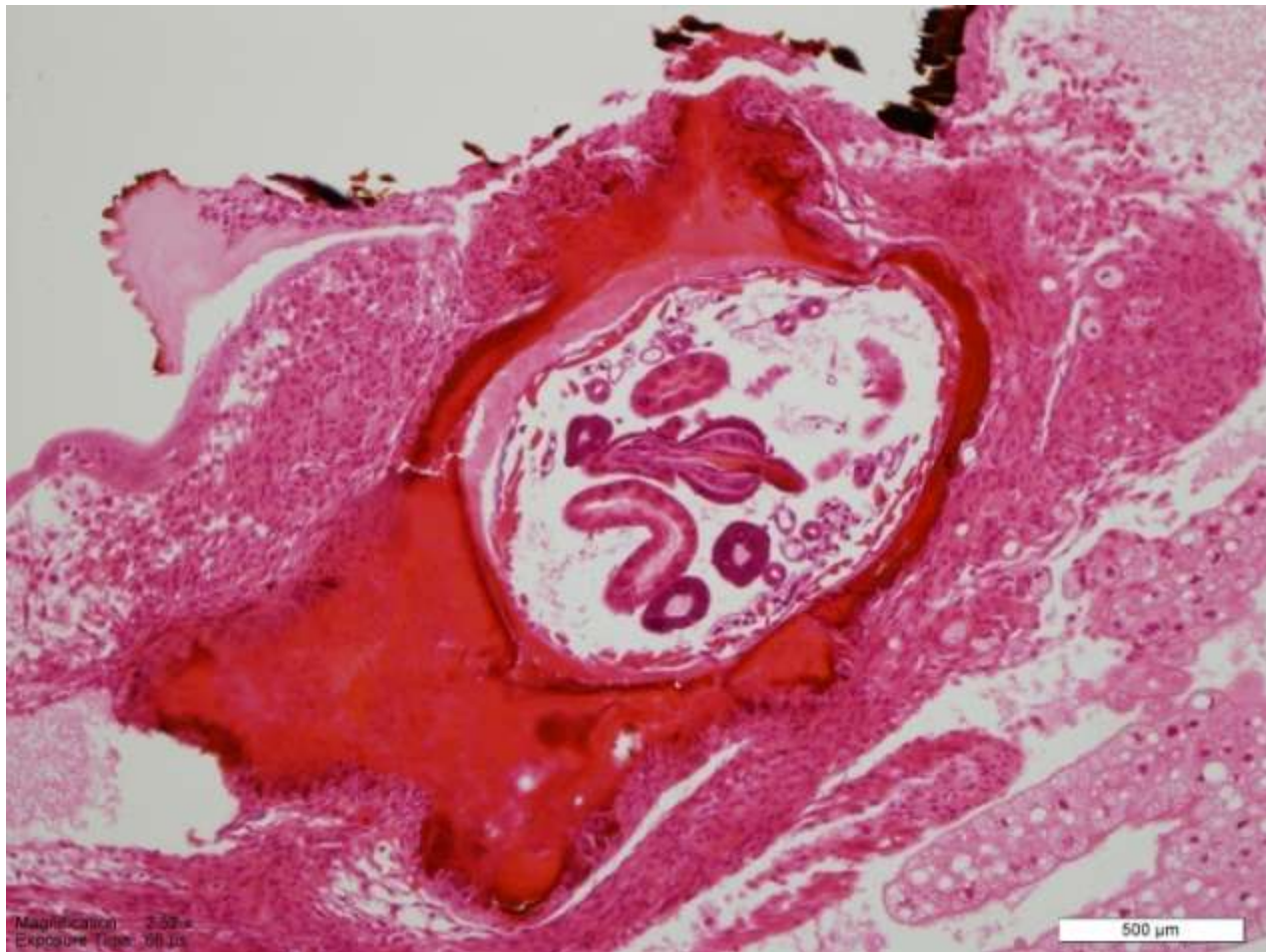
# Coelomocytes



# Melanization Reaction



# Parasite Encapsulation



# Acknowledgements

- William Meek
- Erika Dexter
- Edward Abril
  
- R.E. Chapman, The Insects Structure and Function. Cambridge Univ. Press
- R.E. Snodgrass, Principles of Insect Morphology. Cornell Univ. Press